RAILROAD GAZETTE

FRIDAY, MAY 26, 1876.

MASTER MECHANICS' ASSOCIATION.

Report on Locomotive Tests.

Your Committee, appointed two years ago to make a report on locomotive tests, issued the following circular some months before the meeting of the last annual convention:

"*To the members of the American Railway Master Mechanics' Association:*

"Nearly all master mechanics, in order to determine the relative economy of different kinds of locomotives, or of methods of construction, are in the habit of making experiments, the results of which are recorded with more than ordinary care and accuracy. At the last convention of the American Railway Master Mechanics' Association it was suggested that if these records could be obtained and embodied in the form of a report, that the data thus collected and published would have very great value. It was also thought probable that, if the attention of the members of that Association was called to the subject, some of them who have not heretofore made such experiments might be induced to do so. A Committee was therefore appointed to request members 'to make experimental tests to show the performance of locomotives, and to report the results to the Association.' This Committee, therefore, desire to receive records of *any* experiments which members have made, or may make, with locomotives, to determine their performance. In order to indicate the kind of information and data desired, and also the methods of making experiments of this kind, the Committee will state that it is desirable to know:

"1. The kind of locomotive employed in the experiment, its total weight, the distribution thereof on the wheels, and the principal dimensions of the boiler and engines, their condition, and the length of time it has been in service.

"2. The weight of the train, the distance run, the running time, the grades and curves of the road.

"3. The kind of fuel used, and the weight consumed in hauling the train.

"4. The quantity of water evaporated in doing the work.

"5. The steam pressure employed.

"6. The temperature of the gases in the smoke-box.

"7. The temperature of the fire in the fire-box.

"8. The action of the steam in the cylinders, as shown by indicator diagrams, taken at different speeds and points of cut-off.

"9. The date of the experiment, and the temperature of the air, as indicated by an ordinary thermometer.

"The kind of engine employed can be shown best by a skeleton drawing, which will represent the principal parts only, with dimensions marked on it; but a photograph of the engine is better than nothing. The engine should be weighed in exactly the condition it is in when working, and with two men on it, but uncoupled from the tender. It is important, however, to *know* that the scales used weigh correctly, which it is hardly necessary to say, ordinary track scales often do not. It is also desirable to know the quantity of water which the boiler carries. To determine this, first weigh the engine with the water at the height at which it is ordinarily carried on the road. Then blow *all* the water out of the boiler and weigh the engine again. A suitable blank form is appended hereto, in which the weight and dimensions of the engine can be conveniently entered.

"The weight of the train would of course be most accurately obtained by weighing each car. When this is not practicable, state the number of cars, the number of wheels under each car and whether they were loaded or empty. The distance run is of course easily obtained. The running time should be recorded either with a speed indicator, or by some one noting the time of passing each mile post, and of arriving at and leaving stations. The grades should be shown by a profile of the road on which the radius and length of each curve should be marked.

"It is best, if bituminous coal is used in experiments in which great accuracy is aimed at, to pick the fuel and use lumps of coal only, because otherwise it is impossible to tell what proportion of that used is fine coal or dirt. Before making the experiment, the tender should be carefully swept out, and all the fuel, including that used for kindling, should be *weighed* on scales that are *known* to be accurate. The remaining coal, when the run is completed, should again be weighed, and, of course, be deducted from that first taken. The kind of coal used should also be noted.

"The quantity of water evaporated should be determined by a gauge consisting of a wooden float, similar to that represented in the engraving.*

"It consists of a wooden float, *A*, which is placed on the surface of the water, through the man-hole of the tender. A wooden stem or rod, *B*, which is graduated in inches, is attached to the float. This rod moves easily through a hole in a board, *C*, which is placed in the coping of the man-hole. By observing the height at which this gauge stands after and before the tender is filled, the difference will of course indicate the number of inches of water used. Before making the experiment, the quantity of water contained in each inch should be ascertained by placing the tender on the scales, and then measuring the height of the water and weighing the tender. The water may then be allowed to run out until the gauge indicates 12, or any other number of inches less than at first. If the tender is then weighed again, the difference between the first and the last weight will give the weight of the number of inches of water indicated by the gauge, from which the weight of an inch in height of water in the tender can easily be obtained. If the quantity of water in the boiler before and after the experiment is the same, that which is drawn from the tender will of course represent that which has evaporated, provided none has been wasted by leakage, priming, or by the injector, or for wetting coal, or other purposes. Care should therefore be exercised that there is no waste of water for these or other causes.

"The pressure of steam should be recorded, either by a recording gauge, or by placing an intelligent boy on the engine and have him note the pressure once every minute while the engine is running.

"The temperature of the gases in the smoke-box may be obtained by using two pyrometers. Two should be used, so that the one may be a check on the other. A record of these should be taken once every minute while running a distance of 10 or 12 miles on a level piece of track, and again while going up the steepest grade on the part of the road on which the experiments are made.

"The temperature in the fire-box can be obtained if a piece of wrought iron of known weight, say 60 lbs., is placed in the fire until it is heated up to the temperature of the fire, and then removing it quickly, and placing it in a vessel (of wood preferably) containing a known weight of water, say from 60 to 100 pounds, and observing the temperature of the water before the iron is put in and after, say in ten or twenty minutes, when it has communicated all its heat to the water. These phenomena must, however, be observed and recorded with great care and accuracy, as a trifling error will lead to very erroneous results.

"The indicator diagram should be taken in the ordinary way with the throttle wide open, and the speed at which they are taken noted. The speed can be known if an attendant will count the revolutions of the driving wheels for any given time when the diagram is taken. At ordinary speeds this is possible, but when running fast, a revolution counter or speed indicator will be necessary to be sure of a correct count.

"The Committee, of course, do not expect to procure all the data enumerated above from any ordinary experiments, and, therefore, they request members of the Association to send records of *any* experiments which they may have made recently, *even though the data recorded may be of only one or more* of the phenomena described above. Carefully made experiments, with an accurate record of all the facts referred to in this circular, would, however, have exceptional value at the present time. If experiments are made with engines of peculiar construction, or under unusual circumstances, members are requested to furnish drawings of the peculiarities, and describe the circumstances attending the experiment."

[Here followed a suitable blank for the dimensions and weight of the locomotive experimented with.]

As the Committee did not receive any replies to the first circular, a few weeks before the meeting of the last Convention they issued another, as follows:

"*To the Members of the American Railway Master Mechanics' Association:*

"As the Committee on Locomotive Tests, appointed by your Association, have thus far not received any reports of such tests, they desire to call attention to the last paragraph in the circular referring to this subject, which the Committee issued, and which reads as follows:

"The Committee of course do not expect to procure all the data enumerated from any ordinary experiments, and, therefore, they request members of the Association to send records of *any* experiments which they may have made recently, *even though the data recorded may be of only one or more* of the phenomena described.

"As the object of appointing the Committee was simply to collect together the records of experiments or tests which the members have from time to time made, the Committee request them to forward reports of *any* such experiments made within the past few years, even though no other record of the performance of the engines was kept than the amount of coal consumed and the number of cars hauled. There are a great many reports of this kind in existence, which if collected together and made accessible would be very valuable. The Committee therefore desire to urge members having such records to forward copies to their Chairman as early as possible."

To the latter no replies were received containing sufficient information to enable the committee to make a report, with the exception of a very valuable paper from Mr. Reuben Wells, of the Jefferson, Madison & Indianapolis Railroad, which was handed in too late to report.

This year the Committee issued a circular as follows:

"The Committee on Locomotive Tests, who were appointed at the seventh annual convention of your Association, and who were instructed 'to request members to make experimental tests to show the performance of locomotives, and to report the results to the Association,' were obliged to report at the last convention that they had not received a sufficient number of replies to their circular to make a report. As the Committee was continued for another year, they renew the request made to members of the Association in previous circulars, to send reports of experimental tests made to determine the performance of locomotives. In the first circular the Committee issued, they gave somewhat full particulars of the kind of information which was desired. They will add that they want reports of *any* locomotive tests in which the performance, such as the amount of fuel consumed, water evaporated, load hauled, distance run, and speed of train, is accurately recorded. Members who either have made, or will make such tests, are requested to forward records thereof to M. N. Forney, Chairman of the Committee, No. 73 Broadway, New York."

To this a number of reports of experiments made on different roads have been received, some of them containing information of much value, but at the same time the Committee are compelled to state that up to the present time no series of experimental tests on the performance of locomotives, which were at all comprehensive, have been made, or, to their knowledge, undertaken. That such tests would have very great value and would indicate how a very large saving may be effected, the Committee hope to be able to show from the reports which they have already received. These have been tabulated, so that their results may more easily be compared with each other. Before referring to them, it may be well to state that the object of such tests, as understood by the Committee, is to indicate how goods and passengers can be carried on railroads with the least cost. This is, however, a very complicated problem, and in the solution of which, if proper regard is not given to all the conditions and circumstances which influence it, serious error and entirely false conclusions may result. Thus, if in estimating the performance of a locomotive, regard is given solely to the amount of fuel consumed, we may find that with a very small consumption of fuel per car per mile, there may be other expenses incurred which will increase the total cost of moving the trains and offset any possible saving in fuel. It may, for example, be stated generally that the cost for wages of locomotive runners and firemen, is equal to the cost of fuel. If, then, by reducing the speed of trains one-half, 20 per cent. of the fuel is saved, it is obvious that there would be no saving in train expenses, but a loss, because the wages of locomotive runners, firemen and other train-hands would be doubled. Or if by hauling thirty cars in a train the cost of fuel per car mile is 10 per cent. less than it would be if forty are hauled, then it is also obvious that the total cost is increased, because in the one case the work performed by the runner, fireman and conductor is one-third greater, whereas the cost of fuel is only reduced 10 per cent. It will be seen, then, that in order to make any comparison of the economy of locomotive performance *all* the train expenses should be taken into account. The Committee has therefore prepared a table with headings for the principal dimensions of the engines, character, size and speed of train hauled, number of stops, character of road, kind, quantity and cost of fuel used, steam pressure, condition of the weather, cost of oil and waste, and of wages for all the train men, and a column for the total cost while on the road per train mile, and another per car mile.

The total train expenses should be given in both ways, because there are two classes of trains, in one of which the number of cars is limited, as is the case in most passenger trains and local freight; the other class may consist of as many cars as the engine is capable of hauling, as is usually the case on our main lines, and on roads whose freight consists of some kind of minerals, as coal or ores. In the one case, the trains must be run, no matter how few the number of cars required, and therefore the cost should be estimated by the total expense *per train*. In the other case, there is practically an unlimited number of cars, and the problem is, how to move them over the line at the least cost *per car*. It is of course true, that if the total cost to the company is regarded, that the cost of repairs to the road and to the rolling stock should be taken into consideration, but this the Committee think is beyond the range of their inquiries. By reference to the table, it will be seen that in none of the experiments have they received full information regarding the various elements of expense involved in hauling trains.

Mr. Wells, of the Jeffersonville, Madison & Indianapolis Railroad, made a number of experiments "to determine the quantity of fuel consumed in doing the work in the ordinary way when no special effort was being made to economize, and under the conditions incident to the every day events as they occur in the operations of a road, in which delays in waiting for trains or other causes are included." The first seven experiments were made with passenger trains, and the results, as far as reported, are given in the table. Engine 17, it will be seen from the table, was run with a single exhaust nozzle. This was removed after the seventh test, and, to quote the language of Mr. Wells, "double nozzles 2¾ inches in diameter were substituted. No other changes or alterations whatever were made to the engine, or in the quality of the fuel used. The engine was run by the same man, and under exactly the same circumstances as before." The results of the test under these conditions are given in the 8th experiment, of which Mr. Wells says: "From the result of these tests we find that, with the double-exhaust nozzles, 39 pounds of coal did precisely the same work, both in train hauled and water evaporated, that 58 pounds did with the single nozzle. This marked difference is doubtless due to the increased draft produced by the smaller diameter of the double nozzles, which supplied to the coal in the grate the amount of oxygen necessary to induce a more perfect combustion."

After the 8th experiment "the valves in this engine—No. 17—were removed and new ones substituted, having 1 inch outside and ⅛ inch inside lap. A test was then made with the same trains, and under the same conditions." The results of this test are given in Experiment 9. Mr. Wells says: "The difference due to the increased lap of the valve as shown in that test, is a saving of one pound of coal per mile compared with the previous test, and a decrease of water evaporated of 61 pounds per mile, and a decrease of 1.40 pounds of water evaporated to one pound of coal, but an *increase* of work done to one pound of coal consumed, equal to 1-10 of a ton conveyed one mile."

The 10th and the 11th experiments were made with a freight engine which had a single nozzle during the 10th and a double nozzle during the 11th trial. Mr. Wells' comments on these two experiments are: "The difference in the results of these tests, due to the exhausts, and in favor of the double nozzle is shown to be a saving of 15.4 pounds of coal per mile, and a loss in water evaporated of 0.15 pounds to one pound of coal, but a gain in work done equal to the difference between conveying 4.85 tons 1 mile with the single nozzle and 6.03 tons 1 mile to 1 pound of coal when the double nozzle was used."

Experiment No. 12 was with a freight engine, No. 27. Experiments 13 and 14 were with engine No. 40, exactly similar in pattern and dimensions to No. 27. When the 13th experiment was made, engine 40 had just come out of the shop after having tubes taken out and boiler cleaned. "Previous to taking this engine in the shop, and while the tubes were heavily coated with scale, and while more or less scale had accumulated on the crown sheet, a test was made in order to determine what effect scale and dirt had on the quantity of coal required in order to do a given amount of work as compared with a comparatively clean boiler. This boiler had been in use three years, and made a mileage of over 75,000 miles."

The results of the test are given in Experiment 14. Of this Mr. Wells says: "The extremely cold weather during the time this test was being made doubtless was one reason of the large consumption of fuel. If we ignore that, however, then the difference due to the heavy scale on the heating surfaces of the boiler is as 2.80 is to 5.52. In other words, 1 pound of coal consumed in a clean boiler will convey 5.52 tons 1 mile; while in one heavily coated with scale and dirt, only 2.80 tons can be conveyed the same distance."

Experiments 15, 16 and 17 give the results of ordinary working of passenger and freight engines on the St. Louis, Vandalia & Terre Haute road.

Experiments 18, 19 and 20 were made by Mr. Boon on the Fort Wayne road to determine the coal consumed and water evaporated in ordinary passenger service. A number of indicator diagrams were also sent with Mr. Boon's report, and which are submitted herewith.

Experiments 21, 22, 23 and 24 were made on the Connecticut River road to determine the value of Mr. Gordon H. Nott's improvement of the fire-box, which was applied to engine No. 15. Mr. Stearns, the Master Mechanic of this road, says: "In these experiments the performance of No. 15 shows a saving over that of No. 2 of 20.3 per cent. in one case and of 18.5 per cent. in the other."

An elaborate series of experiments was made on the Lake Shore & Michigan Southern road last year to determine the value of various kinds of fuel. The committee regret that these are too voluminous to give in a report like this. Only a recapitulation was possible, which is given in Experiments 25, 26, 27, 28 and 29. These are valuable chiefly in giving the cost of fuel per train mile and per car per mile.

Experiments 30 and 31 were made by Mr. Howard Fry on the Niagara Falls Branch of the Erie road to try the effect of increasing the lap of the valve. In Experiment 30 the engine had 13-16 in. lap of valve and in Experiment 31 it had 1 inch. It will be seen that with the smallest lap the consumption of fuel is very much larger than with 1 inch lap in the 31st experiment. Experiment 32 was made with one of Mr. Mason's single-boiler double-truck or Fairlie engines, and Experiment 33 was made with an ordinary passenger engine.

The Committee have also received from Mr. William Fuller, General Master Mechanic of the Atlantic & Great Western Railroad, a report of the performance of engine No. 302, operated by that company, and the engine Weston, operated by the inventor of the boiler which is known by the same name. Although not so stated in the report, it is inferred that engine 302 had a boiler of the ordinary construction. The reports of performance it was found difficult to tabulate, so they are submitted in full herewith for publication with the report.

Besides the experiments made which we have tabulated, Mr. Wells made an experiment the report of which we give in his own language. "On making a test, which was continued for 12 hours, it was found that it required 25 pounds of coal per hour to keep up a steam pressure of 80 pounds per inch, in the boiler of engine No. 40, when it was clean and in good order and perfectly tight; the boiler had been lately covered with pine lagging and Russia iron jacket, the dampers to the ash-pan were kept closed, and no steam was allowed to escape or leak out, nor was the engine moved during the 12 hours referred to, nor was there any water put into the boiler during that time, and at the end of the test but little difference in the water level could be noticed from that at the beginning. From this it would seem that 25 pounds of coal per hour is required to make good the heat lost by radiation alone, from a boiler of this size, containing 8,200 pounds of water, under the conditions stated above. At the time of the test the engine stood on a side track, and the temperature of the atmosphere averaged 50 degrees. There was no wind. The test was made March 14. At another time, the same month, a four-wheel switching engine weighing 16 tons was kept under steam for 10 consecutive hours, at an average pressure of 80 pounds. No steam was allowed to blow off, the dampers to ash-pan were kept closed, but during the time the engine was run one quarter of a mile to "pump up," in order to make good the loss of water from the escape of steam through slight leakage at the throttle and safety valves. In this case the consumption of coal was 32 pounds per hour.

Passenger engine No. 21, cylinders 14x22, drivers 5 feet diameter, weight of engine and tender (average) 49 tons, and of the ordinary eight-wheel pattern, running from Indianapolis to Jeffersonville empty, April 12, was run as follows: Time con-

*This engraving was published in the *Gazette* of December 26, 1874.

EXPERIMENTAL TESTS OF LOCOMOTIVES.

No. of Experiment.	Name of Railroad.	Terminal Points on Road between which Experiments were made.	Name of Master Mechanic.	Name of Builder of Locomotive.	Kind of Locomotive.	No. of Locomotive.	No. of Driving Wheels.	Diameter of Driving Wheels.	Length of Driving Wheel-base.	Length of Tgal Wheel base.	Total weight of Engine in working order, in lbs.	Total wt. on Driving Wheels, in lbs.	Total wt. of Water in Boiler, in lbs.	Size of Cylinders.	Size of Steam Ports, inches.	Size of Exhaust Ports, inches.	Greatest travel of Valves, inches.	Lead in full gear, inches.	Outside lap of Valve, inches.	Inside lap of Valve, inches.	Size of Grate, inches.	Outside diam. of smallest ring in waist of Boiler, inches.	Height of fire-box from top of Grate to crown sheet.	Kind of boiler, straight or wagon-top.	One or two domes.	Number of Tubes.	Outside diameter of Tubes.	Length of Tubes.	Material of Tubes.	Square feet of Grate surface.	Square feet of Heating surface in Tubes.	Square feet of Heating surface in fire-box.	Square feet of Heating surface, total.	Exhaust nozzles—single or double.	Diameter of Exhaust nozzle, inches.	Diam. of inside pipe in smoke stack, inch.	Date of experiment.	Kind of service, passenger or freight.	No. of Experiment.
1	Jefferson, Madison & Indianapolis	Louisville & Indianapolis	Reuben Wells	.....	American.	11	4	5'-6"	.....	.....	66,000	42,800	6,400	16x22	11x18	.....	4¾	...	1	1-16	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	752	101	853	.....	.....	.....	Feb. 8-20, '75	Pass.	1
2	" " "	"	.....	.....	"	11	4	"	.....	.....	66,000	42,800	6,400	16x22	.....	.....	4¾	...	1	1-16	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	752	101	853	.....	.....	.....	Jan. 20-30, '75	"	2
3	" " "	"	.....	.....	"	11	4	"	.....	.....	66,000	42,800	6,400	16x22	.....	.....	4¾	...	1	1-16	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	752	101	853	.....	.....	.....	March 8-26,	"	3
4	" " "	"	.....	.....	"	11	4	"	.....	.....	66,000	42,800	6,400	16x22	.....	.....	4¾	...	1	1-16	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	752	101	853	.....	.....	.....	April 1-30, '75,	"	4
5	" " "	"	.....	.....	"	17	4	"	.....	.....	62,000	40,000	5,510	16x22	.....	.....	4¾	...	⅞	1-16	...	...	.....	.....	.....	.....	.....	.....	.....	.....	10	690	89	779	Double	2¾	...	Jan. 29 to Feb. 23, '75	"	5
6	" " "	"	.....	.....	"	17	4	"	.....	.....	62,000	40,000	5,510	16x22	.....	.....	4¾	...	⅞	1-16	...	...	.....	.....	.....	.....	.....	.....	.....	.....	10	690	89	779	Single	3¾	....	.....	"	6
7	" " "	"	.....	.....	"	17	4	"	.....	.....	62,000	40,000	5,510	16x22	.....	.....	4¾	...	⅞	1-16	...	...	.....	.....	.....	.....	.....	.....	.....	.....	10	690	89	779	"	3¾	....	.....	"	7
8	" " "	"	.....	.....	"	17	4	"	.....	.....	62,000	40,000	5,510	16x22	.....	.....	4¾	...	⅞	1-16	...	...	.....	.....	.....	.....	.....	.....	.....	.....	10	690	89	779	Double	2¾	....	Feb. 5-22, '75	"	8
9	" " "	"	.....	.....	"	17	4	"	.....	.....	62,000	40,000	5,510	16x22	.....	.....	4¾	...	⅞	1-16	...	...	.....	.....	.....	.....	.....	.....	.....	.....	10	690	89	779	"	2¾	....	March 7-13, '75	"	9
10	" " "	"	.....	.....	"	17	4	"	.....	.....	62,000	40,000	5,510	16x22	.....	.....	4¾	...	⅞	1-16	...	...	.....	.....	.....	.....	.....	.....	.....	.....	10	690	89	779	Double	2¾	....	March 20-29, '75	Frgt.	10
11	" " "	"	.....	.....	"	19	4	4'-6"	.....	.....	64,200	40,500	6,450	16x24	14x1⅜	.....	5	...	1	1-16	...	...	.....	.....	.....	.....	.....	.....	.....	.....	11	617	91⅜	708⅛	Single	3¾	....	March 30 to April 8, '75	"	11
12	" " "	"	.....	.....	"	19	4	"	.....	.....	64,200	40,500	6,450	16x24	14x1⅜	.....	5	...	1	1-16	...	...	.....	.....	Straight	.....	.....	.....	.....	.....	11	617	91⅜	708⅛	Double	2¾	....	"	"	12
13	" " "	"	.....	.....	"	27	4	5'-6"	.....	.....	72,500	44,900	8,150	17x24	1x18	.....	4¾	...	1	⅜	...	...	.....	.....	"	.....	.....	.....	.....	.....	10	826	97	923	"	2¾	....	March 9-31,	"	13
14	" " "	"	.....	.....	"	40	4	5'-6"	.....	.....	72,500	44,900	8,150	17x24	1x18	.....	4¾	...	1	⅜	...	...	.....	.....	.....	.....	.....	.....	.....	.....	10	826	97	923	"	2¾	....	" "	"	14
15	St Louis, Vandalia & Terre Haute	Western or Vandalia Division.	C.R. Peddle.	.....	"	40	4	5'-6"	7'-9"	21'-4"	72,500	44,900	8,150	17x24	1x18	.....	4¾	...	1	⅜	...	...	.....	.....	.....	.....	.....	.....	.....	.....	10	826	97	923	1 Single	2¾	....	Jan. 7-16,	"	15
16	" " "	"	.....	.....	Mogul.	....	6	55"	14'-6"	21'-10	70,000	60,000	6,800	17x24	16x1⅜	16x2⅜	4¾	1-16	⅝	0	53⅜	...	.....	65	.....	.....	128	2	11'- 7⅜"	.....	682	88.2	770.2	1 & Dou	3⅜	(	.....	Pass.	15
17	" " "	"	.....	.....	American.	....	4	61"	8'	21'-10	66,000	41,760	6,940	16x24	15x1⅜	15x2⅜	4¾	1-16	⅝	0	59⅜	...	.....	66	.....	.....	156	2	11'- 2⅜"	.....	801	98	899	Double	3⅜	16	.....	Frgt.	16
18	Pittsburgh, Ft. Wayne & Chicago	Crestline & Ft. Wayne.	Jas. M. Boone	.....	"	121	4	5'-6"	.....	.....	.....	.....	.....	16x24	15x1⅜	15x2⅜	5⅜	...	1	....	55	...	.....	64⅜	.....	.....	144	2	10'-11⅜"	.....	722	102.8	824.8	Single	3⅜	16	.....	"	17
19	" " "	"	.....	.....	"	121	4	5'-6"	.....	.....	.....	.....	.....	16x24	15x1⅜	15x2⅜	5⅜	...	1	....	60	48⅜	.....	58⅜	.....	.....	.....	1⅜	11'	.....	.....	.....	.....	.....	.....	.....	.....	Oct. 27, '75	"	18
20	" " "	"	.....	.....	"	121	4	5'-6"	.....	.....	.....	.....	.....	16x24	15x1⅜	15x2⅜	5⅜	...	1	....	60	48⅜	.....	58⅜	.....	.....	.....	1⅜	11'	.....	.....	.....	.....	.....	.....	.....	.....	Oct. 29, '75	"	19
21	Connecticut River	.....	W. H. Stearns	.....	"	15	..	.....	.....	.....	.....	.....	.....	16x22	.....	.....	.....	...	...	....	50	...	.....	58	.....	.....	121	2	10'-11"	.....	.....	.....	.....	.....	.....	.....	.....	Oct. 31, '75	"	20
22	" " "	"	.....	.....	"	15	..	.....	.....	.....	.....	.....	.....	16x22	.....	.....	.....	...	...	....	50	...	.....	58	.....	.....	121	2	10'-11"	.....	.....	.....	.....	.....	.....	.....	.....	Dec. 30, '75, to Jan. 5, '76	Frgt.	21
23	" " "	"	.....	.....	"	2	..	.....	.....	.....	.....	.....	.....	16x24	.....	.....	.....	...	...	....	58	...	.....	61⅜	.....	.....	143	2	11' -3"	.....	.....	.....	.....	.....	.....	.....	.....	" "	"	22
24	" " "	"	.....	.....	"	2	..	.....	.....	.....	.....	.....	.....	16x24	.....	.....	.....	...	...	....	58	...	.....	61⅜	.....	.....	143	2	11' -3"	.....	.....	.....	.....	.....	.....	.....	.....	" "	"	23
25	Lake Shore & Michigan Southern	Elkhart and Chicago.	Jas. Sedgley.	.....	Mogul.	466	6	.....	.....	.....	.....	.....	.....	16x24	.....	.....	.....	...	...	....	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	" "	"	24
26	" " "	"	.....	.....	American.	79	4	.....	.....	.....	.....	.....	.....	17x24	.....	.....	.....	...	...	....	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	November, '75	Frgt.	25
27	" " "	"	.....	.....	"	452	4	.....	.....	.....	.....	.....	.....	17x24	.....	.....	.....	...	...	....	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	" "	"	26
28	" " "	"	.....	.....	"	13	4	.....	.....	.....	.....	.....	.....	16x24	.....	.....	.....	...	...	....	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	" "	"	27
29	" " "	"	.....	.....	"	121	4	.....	.....	.....	.....	.....	.....	17x24	.....	.....	.....	...	1⅛	....	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	" "	"	28
30	Erie Railway	Niag'a Falls Branch.	Howard Fry.	Brooks.	" ‡	....	4	5'..	.....	.....	.....	.....	.....	16x24	.....	.....	.....	...	1⅛	....	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	June 23 to July 3, '74	Frgt.	29
31	" " "	"	.....	.....	"	....	4	5'..	.....	.....	.....	.....	.....	16x24	.....	.....	.....	...	...	....	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	July 10-18, '74	"	30
32	" " "	"	.....	.....	Mason.	....	4	4'..	.....	.....	.....	.....	56,000	15x22	.....	.....	.....	...	...	....	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	June, 1874	"	31
33	" " "	"	.....	.....	Brooks.	....	4	5'-8"	.....	.....	.....	.....	.....	18x22	.....	.....	.....	...	...	....	...	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	November, 1872	Pass.	32

No. of Experiment.	Average Number of Cars hauled. Baggage.	Express.	Passenger.	Sleeping.	Freight.	Caboose.	Total.	Wt. of Cars* Approximate.	Actual.	Total weight in lbs. of train, including locomotive and tender.†	Dist. run by train, in miles.	Average running speed inclusive of stops, in miles per hour.	Average running speed exclusive of stops, in miles per hour.	Total amount of time on road.	Average No. of miles run to one stop.	Maximum grade on rd. in feet per mile.	Vertical dist. in ft. bet. highest & low't pt. on rd	Shortest radius of curve.	Kind of fuel used.	Cost of fuel per ton of 2,000 lbs.	Quantity of wood used for kindling, in cords.	Cost of wood.	Average weight of coal in lbs. consumed per train mile.	Average weight of coal in lbs. consumed per car mile.	Cost of fuel and kindling per train mile, cts.	Cost of fuel and kindling per car mile, cts.	Pounds of water evaporated per pound of coal.	Pounds of water evaporated per train mile.	Pounds of water evaporated per minute while running.	Wt. of train in lbs. inc. engine and tender conveyed 1 mile pr. lb. coal	Maximum steam pressure.	Average steam pressure.	Average temperature of gases in smoke-box.	Average temperature of fire in fire-box.	Maximum temperature of fire in fire-box.	Average temperature of atmosphere during experiment, degrees.	State of the weather, height of barometer.	Quantity of oil used for lubricating.	Cost of oil per train mile.	Cost of oil per train mile.	Quantity of oil used for engine, train and signal lights.	Cost of oil per train mile.	Cost of oil per train mile.	Cost of waste, rags and packing per train mile.	Cost of locomotive runner and fireman's wages per mile.	Cost of brakemen and conductors.	Total train expenses while on road, per car, per mile.	Total train expenses while on road, per mile run.	No. of Experiment.
1	...	...	...	...	...	...	3.18	....	.....	282,000	1,344	.....	.....	.....	6	78	260	....	Pittsburg Coal	....	.....	.....	31¼	9.82	.....	.....	.....	363	130	9,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
2	...	...	...	...	...	...	3.6	....	.....	302,000	1,344	23.3	.....	.....	6	78	260	....	Ashland, of Ky.	....	.....	.....	31¼	8.68	.....	.....	.....	.....	...	9,640	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
3	...	...	...	...	...	...	3.5	....	.....	300,000	2,016	23.4	.....	.....	6	78	260	....	Pitts. and Ind. Coal	....	2½	.....	38¾	11.07	.....	.....	.....	.....	...	7,760	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3
4	...	...	...	...	...	...	3.5	....	.....	300,000	3,136	23.4	.....	.....	6	78	260	....	.....	....	.....	.....	28	8.	.....	.....	.....	.....	...	10,700	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4
5	...	...	...	...	...	...	3.57	....	.....	290,000	672	23.2	.....	.....	6	78	260	....	.....	....	.....	.....	58	16.24	.....	.....	4.75	276	113	5,000	.....	.....	.....	.....	26.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5
6	...	...	...	...	...	...	3.57	....	.....	290,000	672	23.2	.....	.....	6	78	260	....	.....	....	.....	.....	54	15.14	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6
7	...	...	...	...	...	...	3.57	....	.....	290,000	672	23.2	.....	.....	6	78	260	....	.....	....	.....	.....	57	16.	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7
8	...	...	...	...	...	...	3.57	....	.....	290,000	1,344	23.2	.....	.....	6	78	260	....	.....	....	.....	.....	39	10.92	.....	.....	6.95	271	....	7,440	.....	.....	.....	.....	23.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8
9	...	...	...	...	...	...	3.57	....	.....	290,000	678	23.2	.....	.....	6	78	260	....	.....	....	.....	.....	38	10.64	.....	.....	5.55	210	....	7,620	.....	.....	.....	.....	50.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9
10	...	...	...	...	...	...	21 8	....	.....	846,000	684	8.8	.....	.....	6	5	78	260	.....	....	.....	.....	87¾	4.	.....	.....	5.57	486	....	9,780	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10
11	...	...	...	...	...	...	22.2	....	.....	866,000	684	8.8	.....	.....	5	5¾	78	260	.....	....	.....	.....	71¾	3.23	.....	.....	5.42	390	....	12,040	.....	.....	.....	.....	90.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11
12	...	...	...	...	...	...	24.4	....	.....	1,088,000	1,482	9.	.....	.....	5¾	...	78	260	.....	....	.....	.....	98	4.01	.....	.....	.....	.....	...	11,100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12
13	...	...	...	...	...	...	22.7	....	.....	906,000	1,596	9.	.....	.....	5¾	...	78	260	.....	....	.....	.....	82	3.61	.....	.....	.....	.....	...	11,040	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13
14	...	...	...	...	...	...	19.3	....	.....	720,000	684	8.35	.....	.....	5¾	...	78	260	.....	....	.....	.....	129	6.68	.....	.....	.....	.....	...	15,600	.....	.....	.....	.....	12.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14
15	1	1	2	3	24	1	7	444	.....	439,950	165⅜	27.58	.....	.....	33.1	52.	...	...	.....	....	.....	.....	51.9	7.41	.....	.....	.....	.....	...	3,480	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15
16	...	...	...	...	...	...	25	....	.....	1,011,000	.....	12	.....	.....	.....	42.	...	...	.....	....	.....	.....	76.5	3.06	.....	.....	.....	.....	...	8,900	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16
17	...	...	...	...	24	1	23	....	.....	933,000	73	.....	.....	.....	.....	...	...	...	.....	....	.....	.....	71.2	3.09	.....	.....	.....	.....	...	13,100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	17
18	1	1	2	...	.....	...	.....	....	137,280	260,180	131.2	.....	16	.....	4.7	30	...	...	Ohio Coal	....	.....	.....	26.9	.....	.....	.....	6.725	....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18
19	1	1	2	2	.....	...	.....	....	137,280	260,180	131.2	.....	16	.....	4.7	30	...	...	" "	....	.....	.....	22.8	.....	.....	.....	7.161	....	...	11,411	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	19
20	2	2	2	2	.....	...	8	....	325,630	448,530	131.2	.....	29	.....	10.1	30	...	...	" "	....	.....	.....	42.33	5.3	.....	.....	5.832	....	...	10,600	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	20
21	...	...	...	...	.....	...	13.22	.....	.....	.....	600	.....	.....	.....	.....	32	...	...	.....	....	.....	.....	36.6	2.773	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	21
22	...	...	...	...	.....	...	12.2	.....	.....	.....	600	.....	.....	.....	.....	32	...	...	.....	....	.....	.....	34.75	2.84	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	22
23	...	...	...	...	.....	...	18.12	.....	.....	.....	600	.....	.....	.....	.....	32	...	...	.....	....	.....	.....	55	3.034	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	23
24	...	...	...	...	.....	...	13.43	.....	.....	.....	600	.....	.....	.....	.....	32	...	...	.....	....	.....	.....	43.8	3.28	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	24
25	...	...	...	...	32.07	...	32.07	.....	.....	.....	1,358	.....	.....	.....	.....	...	...	...	Bituminous Coal	....	.....	.....	73.05	.....	.1476	.0046	.....	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25
26	...	...	...	...	34.05	...	34.05	.....	.....	.....	1,358	.....	.....	.....	.....	...	...	...	" "	....	.....	.....	76.87	.....	.1585	.0045	6.1	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26
27	...	...	...	...	32.5	...	32.5	.....	.....	.....	1,358	.....	.....	.....	.....	...	...	...	" "	....	.....	.....	70.1	.....	.1454	.0045	5.7	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	27
28	...	...	...	...	33.2	...	33.2	.....	.....	.....	582	.....	.....	.....	.....	...	...	...	Wood	....	.....	.....	.....	.....	.....	.0051	6.6	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28
29	...	...	...	...	29.87	...	29.87	.....	.....	.....	776	.....	.....	.....	.....	...	...	...	"	....	.....	.....	.....	.....	.....	.0061	.....	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	29
30	...	...	...	...	12.8	...	12.8	....	439,636	.....	.....	27.43	.....	.....	.....	...	...	...	Bituminous Coal	....	.....	.....	55.46	4.47	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30
31	...	...	...	...	12.	...	12.	....	382,055	.....	.....	21.42	.....	.....	.....	...	...	...	Towanda Coal	....	.....	.....	36.34	3.391	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31
32	...	...	...	...	24.7	...	24.7	....	1,200,096	.....	.....	18.52	.....	.....	.....	...	...	...	Anthracite Coal	....	.....	.....	72.00	2.915	.....	.....	.....	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	32
33	...	...	...	...	..	...	6.5	....	373,184	.....	.....	31.53	.....	.....	.....	...	...	...	.....	....	.....	.....	52.1	8.03	.....	.....	5.59	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	33

* By "approximate weight" is meant the weight as near as it can be ascertained without weighing the cars. The "actual weight" is the weight taken on a pair of scales.

† The weight of tender should be given half full of water and fuel.

‡ This engine had a Jauriet fire-box and one of Reed's steam superheaters.

sumed in running 108 miles, 4 hours 55 minutes; time consumed waiting at stations, 1 hour 5 minutes; total, 6 hours; stops made, 6; average speed, when running, 22 miles per hour; average steam pressure, 100 pounds; coal consumed per mile, 18¼ pounds; water evaporated per mile, 109 pounds; water evaporated to 1 pound of coal, 5.91 pounds; water evaporated per minute while running, 40 pounds; tons (of engine and tender) conveyed 1 mile to 1 pound of coal, 2.60; heating surface of fire-box, 77 feet; of tubes, 598 feet; total, 675 square feet; coal used, "Indiana block coal."

By measuring the wood it was found that ordinarily it required one-sixth of a cord to raise steam in a boiler to 80 and 100 pounds pressure, the boiler being cold at the time of beginning."

Mr. Hayes made experiments to determine the quantity of fuel consumed by a locomotive and tender alone, without any cars or train, of which we give his report, as follows: "On June 26 and 27, 1872, engine No. 131 ran from Chicago to Centralia, and used 6,427 lbs. of coal; distance, 252¼ miles; no train.

"On May 21, 1874, engine 31 ran from Chicago to Champaign, and consumed 2,689 lbs. of coal; distance, 128 miles; no train.

"On July 6, 1874, engine 42 ran from Chicago to Champaign, 128 miles, and used 2,457 lbs. of coal; no train. Engine 131 has 15-in. cylinders and wheels 5 ft. diameter. Engine 31 has 15-in. cylinders and 5½ ft. wheels. Engine 42 has 15-in. cylinders and 5 ft. wheels. I think better results could have been obtained with engine 131."

Several tests were made by Mr. Wells with engine 35, working on the incline-plane at Madison, the results of which are so interesting that we give his report in full. They were made April 9 and 10, "to determine the quantity of fuel consumed in doing a given amount of work, and the adhesion of the wheels to the rails, in proportion to the weight, which can be relied on under ordinary circumstances. This engine is what is called a tank engine: the cylinders are 20½×24 inches; steam ports, 1⅛×18 inches; valve, ¾ outside and 1-16 inside lap, and 4¾ inches throw. The wheels are all drivers, and consist of five pair, 44 inches in diameter; tires, steel; heating surface of fire-box, 114 feet, and of tubes 1,170 feet; total, 1,284 feet; average weight of engine with water and fuel, 54 tons.

The inclined plane is 6,940 feet in length, and the track is inclined 1 in 16½=320 feet per mile. A train of eight loaded cars was taken up this grade as follows:

Weight of engine, 54 tons; weight of train, 154 tons; total, 208 tons; speed at starting on the incline, 2 miles per hour.

Left foot of plane at 3:40 p. m., steam pressure 140 lbs., cut off 19 inches.

Left foot of plane at 3:45 p. m., steam pressure 140 lbs., cut off 19 inches.

Left foot of plane at 3:50 p. m., steam pressure 143 lbs., cut off 19 inches.

Left foot of plane at 3:52 p. m., steam pressure 140 lbs., cut off 19 inches.

Arrived at top of plane at 3:58 p. m., steam pressure 130 lbs., cut off 19 inches.

Average speed, 6.06 miles per hour; fuel consumed, 0.56 cord of wood; time consumed in overcoming the elevation of 420 feet, 13 minutes.

The power requisite to overcome the force of gravity on this incline would be 1-16.5 the total weight of the train, or 25,212 pounds, and if we add eight pounds per ton for rolling and journal friction, we have then a total of 26,876 pounds. To overcome this, an effective pressure of 122 pounds per square inch is required, which is equivalent to 434 horse power, or 14,324,908 foot-pounds per minute. The weight on the drivers available for adhesion on the incline is 1-16½ less than the weight on a level track, and in this case would be 101,455 pounds.

Leaving off the power absorbed in rolling and journal friction of the engine, the adhesion of the drivers to the rails required to take this engine and train up the grade would be 25,286 pounds, or 24¾ per cent. of their total weight on the rails. The rails were dry and there was no indications of slipping at any time, and no sand was used; therefore we may conclude that the adhesion of a steel tire to a dry iron rail, at slow speeds, and on a straight track, is, in round numbers, at least 25 per cent. of the weight on the rail. Another test was made April 10 with the regular passenger train. Weight of engine and train, 99 tons; speed at foot of inclined plane, 8 miles per hour; time consumed ascending or running 6,940 feet, 5¼ minutes; average speed 14.6 miles per hour. Steam pressure in the boiler ranged from 127 to 135 pounds and averaged 132 pounds. Valves cut off steam to the cylinders at 12 inches of the stroke.

Power developed running on the incline was 15,107,000 foot-pounds per minute=457 horse power; fuel consumed, 0.25 cord of wood.

TEST OF ENGINES, ATLANTIC & GREAT WESTERN RAILROAD.

ENGINE 302, RECAPITULATION.

	Trip No. 1.	Trip No. 2.	Trip No. 3.	Total.
Miles run	100	100	100	300
Actual running time	7 h. 54 m.	7 h. 32 m.	6 h. 59 m.	22 h. 25 m.
Average number loaded cars hauled	24	23⅝	24	23 8-9
No. pounds of coal used	5,213	4,989	5,015	15,217
Dynamometer:				
Starting power	93,600	87,800	78,300	259,700
No. times taken	10	9	9	28
Average power between stations	93,500	95,800	96,000	285,000
No. times taken	15	15	15	45

ENGINE "WESTON," RECAPITULATION.

	Trip No. 1.	Trip No. 2.	Trip No. 3.	Total.
Miles run	100	116¼	100	316¼
Actual running time	9 h. 27 m.	8 h. 31 m.	7 h. 32 m.	25 h. 30 m.
Average number loaded cars hauled	23¾	23¾	24	23 5-6
No. pounds of coal used	4,642	6,000	5,410	16,052
Dynamometer:				
Starting power	75,700	167,600	125,300	368,600
No. times taken	8	15	12	35
Average power between stations	97,500	119,500	99,500	316,500
No. times taken	16	17	15	48

Comparison.

	Engine 302.	Engine "Weston."
Miles run per ton of coal	39.43	39.43
Average miles per hour	13.48	12.41
Average No. of cars hauled 1 mile per ton of coal.	941.43	939.85
Average pounds of coal used per mile	50.72	50.71
General average of starting power at stations	9,275.00	10,531.43
General average of power hauling trains between stations	6,333.33	6,593.75

The wood used in both tests was beach and oak, nearly dry, and the fuel left in the firebox, water in the boiler and steam pressure corresponded with the same at the beginning, as nearly as could be determined."

The Committee submit their report as much, or perhaps more, on account of the information it does not contain as for that which the members have contributed. They have printed their table with headings which indicate the kind of information that is desired, and which they think is needed to determine what engines are the most economical for various kinds of traffic. It will be seen, however, that the spaces under many of the headings are entirely blank, indicating that no information has been received relating to those topics. What they desire is, that in a future year they may be able to compile, as indicated in the last column, the cost of transporting cars and trains, and they have kept in mind, and hope to impress it upon members of the Association, that the final standard of estimating all kinds of railroad service is expressed in dollars and cents, and not in pounds and tons or in feet and inches.

M. N. FORNEY,
WM. WOODCOCK.

REPORT ON BOILERS AND FIRE-BOXES.

To the American Railway Master Mechanics' Association:

GENTLEMEN: At your last annual meeting the undersigned were appointed a committee on the subject of the "Best Materials, Form and Proportions of Locomotive Boilers and Fire-boxes, with the request that we should report to you, as the result of our investigations, such facts as might seem to us worthy of your attention.

Your committee issued a circular in which such questions were asked as appeared to us most likely to elicit the desired information on the several subjects assigned to us for investigation. But, as these subjects covered much ground, the questions asked were necessarily numerous and some of them of considerable length, we have concluded to omit them from our report, and in their stead to give only the substance of them, in their proper order and place. Before considering these questions, however, we deem it proper, in justice to ourselves, to state that out of about two hundred members belonging to our Association, who are at this time in charge of the Locomotive Department on the different roads in the country—but 19 of that number have made any reply to the circular of your committee. Therefore instead of being able to present to you conclusions formed from the experience and observation of a very large proportion of those in charge of the locomotives in use in the United States, we are obliged to base them mainly on the facts presented by the 19 referred to added to that of our own.

THE BEST MATERIAL FOR THE SHELL OF THE BOILER.

Answers to this question were received from those having an aggregate of 1,690 coal-burning locomotives under their supervision, 276 of which are reported as having steel boilers entire. Those representing 602 locomotives express their preference for good iron, while those representing 1,088 consider steel to be the best material, all things considered.

We find that on roads where steel has been the most largely used, such as the Lake Shore & Michigan Southern, Pittsburgh, Fort Wayne & Chicago, and the Central Railroad of New Jersey, the preference by those in charge is decidedly in its favor. The question between the use of iron and steel for the shell of the boiler, under our limited experience in the use of the latter metal, cannot at present be very satisfactorily determined.

As a committee, we would call attention to the fact of the superior tensile strength of steel over iron, less liability to injury, or to prove defective from flanging and other manipulations, and to the fact that the cost of constructing a steel boiler, aside from the difference in the first cost in the plates, is no greater than that of an iron boiler, and that difference of first cost would not exceed from one to two hundred dollars in the total cost of the boiler.

If steel possesses greater strength than iron, and is equally or more pliable, then a boiler made of it should be stronger and safer than one made of iron, other things being equal; and where that is the case the matter of one or two hundred dollars in the first cost is scarcely worth considering. In the use of steel for the shell of a boiler, we would recommend that the same thickness of sheets be used that has heretofore been adopted in the use of iron. It is a matter of vital importance that the boiler should always have abundant strength for the pressure carried, and in its construction and maintenance this matter should receive pre-eminent attention.

THE BEST MATERIAL FOR FIRE-BOXES.

To this question we have received the same answer from all, with the exception of Mr. Graham, of the Delaware, Lackawanna & Western Railroad. All the others give steel the preference over any other metal. Mr. Graham states that his experience has been with corrugated iron mostly, and on that account he gives it the preference. He states also that he is now using a steel fire-box with one of the side sheets corrugated, while the other is plain, and that he intends doing the same with an iron fire-box, in order to test the relative merits of corrugation, and also that of steel and iron, in the use of anthracite coal, which is exclusively used on that road.

As steel of a low grade has so firmly established itself in favor, and is almost universally used for the fire-box sheets of coal-burning locomotives, we do not consider it necessary to present the relative merits of steel, iron and copper, but we may safely conclude that steel is the best. Steel of a low grade seems to meet all the requirements, if we except its tendency to crack, in the case of the large side sheets of the fire-box. This tendency is not confined to steel, but reports show that iron has the same tendency, in an equal, if not greater degree, besides its liability to blister from imperfect welding in the process of manufacture, or, in other words, from not being perfectly homogeneous. The tendency to crack is not confined to any one kind of steel, nor to one manufacture, but from the reports we learn that sheets have ruptured which have been made by all the different manufacturers whose steel is in general use, both that made by what is known as the "Siemens-Martin," or open hearth process, and the "crucible."

With the above facts before them, your committee deemed it important to direct their inquiries mainly to the causes which result in these mysterious ruptures that sometimes occur in the larger sheets of a fire-box without any apparent cause at the time. In our investigation we have had reported to us 1,690 coal-burning locomotives. Of this number, 232, having steel fire-boxes, burned anthracite coal, and 1,040 burned bituminous coal, 388 had iron fire-boxes, and 30 copper.

Those engines in which anthracite coal was burned had mostly the long and shallow fire-boxes, from 7 to 9 feet in length, and the sheets reported as ruptured within the past two years were only one; yet it is proper to state, that at least in one case, that of the Central Railroad of New Jersey, the number of ruptured sheets is not given. Mr. Woodcock, in his report to us, refers to such sheets, but gives no data as to their number.

The 1,040 engines with steel fire-boxes in which bituminous coal was burned have comparatively deep fire-boxes, the side sheets of which are from 5 feet, to 5 ft. 6 in. long, and 4 ft. 6 in. to 5 feet from crown sheet to the grate.

The number of sheets ruptured in these fire-boxes within the past two years is reported to be 125; of this number 121 were side sheets, 3-door or back sheets, and 1 tube sheet.

We also learn that in 118 of these back sheets, rupture occurred near the vertical center line, and in nearly every case the crack was vertical. A few, however, took a more or less diagonal direction a part of the distance.

The beginning of all these cracks was, in every case reported at a stay bolt, hollow-stay or rivet; and from 6 to 12 inches above the grate. In these cases reported side sheets have ruptured near the forward lower corner, the crack starting about 6 inches above the grate at a stay bolt, and extending upward and forward at an angle of 30 degrees from a perpendicular. Only three back sheets are reported as having ruptured. In two of these the crack starting from rivets at the fire door, and extending diagonally downward some 12 or 14 inches. No report is made of any crown sheets having ruptured, and but one tube sheet, which is stated to have cracked from some obstruction occurring in the water space below the tubes. We find that rupture, in the cases reported, occurred under various and nearly all circumstances, except when the boiler was under steam with fire on the grate. In some cases it occurred while the boiler was being washed out, in others while filling with cold water; sometimes when standing empty, at others while cooling down and nearly cold; sometimes after standing a day or two, or while stay-bolts were being calked, or other work producing a jar or vibration of the sheet; and in a few cases the rupture took place just after a fire was started in firing up, and before steam was raised in the boiler. It seemed to us that the questions demanding a solution, then, are: Why is it that the side sheets only of the comparatively deep and large fire-boxes are ruptured, under the circumstances named, and that the proportion of rupture in those that are long and shallow is so much less than in the deep and large boxes? Why is it that when rupture takes place the crack is almost invariably vertical, and not far from the vertical centre line, and at a point where the heat is usually the greatest? Why is it that some side sheets rupture—others, subjected to precisely the same treatment, under the same circumstances, do not? And is there a remedy that will largely, if not entirely, prevent the evil referred to?

With a view of being able to suggest a remedy, your committee desired first to ascertain the cause; and in their circular asked such questions as seemed most likely to elicit the desired information, giving us the particular circumstances under which rupture occurs and the conditions that existed at the time.

From the reports made to us, we learn that there is a wide difference in the quality of the water used in the boilers on the several roads, in regard to its purity and deposits left in the boiler from its use. That used in the boilers of the Lake Shore & Michigan Southern, Kansas Pacific, Eastern Division of the Terre Haute & Indianapolis, Western Division of the Pittsburgh, Fort Wayne & Chicago, and Northern Division of the Illinois Central railroads leaves heavy and solid deposits of scale on the heating surfaces. An analysis of the water used on the Northern Division of the Illinois Central shows that it holds in solution 84 grains of solid matter to the gallon. Now the five roads referred to have in use 656 steel fire boxes, and in these 105 side sheets, or 8 per cent. of the whole number, have ruptured within the past two years.

The other roads using bituminous coal, where water of a medium or a good quality is used in boilers having an aggregate of 380 steel fire-boxes in use, have had but 16 sheets ruptured, or 2 per cent. of the whole number of side sheets in them.

From these facts it would seem that impure water, from which heavy deposits of scale are formed on the sheets, has a very marked effect on the side sheets, as regards their tendency to rupture.

We find, also, that with but a very few exceptions the water space, where rupture occurred, was but three inches. The sheets, except in a few cases, were 5-16 in. thick. Those reported by the Fort Wayne and Illinois Central roads were, however, but ¼ in. thick.

Mr. Sedgley, of the Lake Shore & Michigan Southern Railway, reports that the water used in the boilers on that road is obtained from lakes, rivers, creeks and surface reservoirs, and that it holds in solution lime, salt, magnesia, sulphur, etc., and these substances are deposited in considerable quantities on the heating surfaces of the boiler in the form of scale. On that road, with 304 steel fire-boxes in use in coal-burning engines, 61 side sheets are reported to have ruptured within the past two years, and the scale on such sheets was about 1-16 in. thick.

This thickness is doubtless greater than that usually found on the side sheets, and may be the means of producing the forces that result in rupture. Out of 608 side sheets, 61, or a fraction over 10 per cent., have cracked.

On the Kansas Pacific road, with 94 steel fire-boxes in use, 10 sheets have ruptured, being about 5¼ per cent. of the whole number of side sheets; and Mr. Waugh states that the scale on those sheets was about ⅛ of an inch thick and composed mainly of carbonates of lime and alkali and salt, etc.

Mr. Peddle, of the Terre Haute & Indianapolis Railroad, reports that out of 50 steel fire-boxes in use on that road, five side sheets have ruptured, being 5 per cent. of the side sheets. He states that considerable scale had accumulated on those sheets, but the thickness could not be ascertained: most of it had been knocked off in cutting out the pieces preparatory to patching. An analysis of scale formed from the water used was made by Dr. Jenkins, of Louisville, Ky., in 1873, and shows it to have been composed principally of the carbonate of lime and magnesia, with a considerable amount of alumina, some sulphate of magnesia, etc., producing a very hard and solid scale.

On the Northern Division of the Illinois Central road, where the water used in boilers contains 84 grains of solid matter to the gallon, the proportion of ruptured side sheets to the whole number in use is reported to have been 6 per cent.; but on the Chicago Division, where the water used contains but about 23 grains of solid matter to the gallon, the number of cracked side sheets to the whole number in use was but a little over 2 per cent. On the Southern Division of this road, where about the same number of steel fire-boxes are in use, and where no deposit is left in the boilers from the water used, except that commonly called mud, not a single instance of rupture has occurred in a sheet. The water used in boilers on the Western Division of the Pittsburgh, Fort Wayne & Chicago Railway is reported to be similar to that on the Northern Division of the Illinois Central, forming a hard scale. The number of side sheets ruptured during the past two years was 21, or 13¼ per cent. of the whole number in use. The water-spaces were 3½ inches, sheets ¼ inch thick; 60×62 inches in size. We find that on several other roads where the water, in regard to purity, is reported medium, the proportion of ruptured sheets to the whole number in use range from 1 to 2 per cent. In one case, however, that of the Little Miami, it is 7½ per cent.; and in another, the Jeffersonville, Madison & Indianapolis, the proportion is 4¼ per cent. In these instances considerable scale had formed on the sheets that cracked, and we think it quite probable in every case where sheets have ruptured in the manner stated, that more or less scale had previously formed on the sheet, preventing the water from coming in direct contact with it; and as scale is a poor conductor of heat, the sheet in such a case is likely to have been injured by over-heating, not from any direct action of the heat tending to change the nature of the steel, but from strains brought upon the different parts of the sheet by unequal expansion. While the sheet is clear of scale, it is in direct contact with the water, and while in that condition its temperature cannot much exceed that of the water, and no injurious strains can be produced in any part of it from unequal expansion, consequent on unequal temperature. *No instance is mentioned of a new and clean sheet having ruptured;* but only those that have been in use long enough to have accumulated more or less scale. Your committee have examined a large number of specimens cut from side sheets that have ruptured under different circumstances, and find a wide difference in the quality of the steel as it appeared at the time, ranging from that which could be doubled down cold without showing any fracture at the turn, to that which could scarcely be bent at all without breaking. In some cases such pieces were drawn under a hammer, then tempered and found to be hard enough to cut iron, while others would not receive a temper at all; showing that there was an original difference between the different sheets. If none but sheets that show a large per cent. of carbon, and which are hard and comparatively brittle, were known to crack, we might attribute this peculiarity entirely to the nature of the steel in the sheet;

but we find that sheets which were extremely tough, so much so that pieces cut out immediately alongside the crack could be bent cold, just as taken from the fire-box, and doubled down, the two parts coming together, without showing a fracture at the turn; the turn running in a direction parallel with the crack, and only about two inches from it. Yet such side sheets have ruptured precisely in the same way and under the same circumstances as those in which the steel was hard and brittle. A case of this character came under the observation of one of your committee a short time ago. The rupture occurred after the engine had been standing in the house eighteen hours, and while a stay bolt, some two feet away from where the crack started, was being calked. The usual quantity of water was in the boiler, which had not yet become entirely cold. The crack started at a hollow stay bolt near the vertical centre of the side sheet, about 8 inches above the grate, and took a vertical direction upward, but downward the direction was diagonal, the length being 20 inches; and the widest part in the crack was at the stay bolt at which it started, *A*, Fig. 1, and measured 1-20 of an inch. Parts of this sheet cut out preparatory to patching were doubled cold, just as taken out, in a direction so that the turn was parallel with the crack, yet no fracture at the turn was produced. Fig. 1 represents the part of the sheet in which rupture occurred, and the direction of the crack.

Now it would seem that metal showing such toughness as the pieces cut out along side this crack could not be ruptured as this was, instantaneously and with a loud report. Yet these are the facts, and they accord with those stated in numerous other cases. We may infer, then, that the quality of the metal does not always prevent rupture, though the usual tests may show it to be of the very best.

Your committee are of the opinion that a combination of several causes takes place previous to rupture, and that the proportions of the side sheets also have much to do with that tendency.

As stated before, in almost every case it has been in the large side sheets that rupture has occurred. Then we may inquire why these side sheets crack and not the other sheets in the fire-box?

Fig. 2 will serve to illustrate by representing a side sheet, *D*. The line *A B* represents the top of the grate, *E F* the mud rising at the bottom of the fire-box.

We believe we are correct when we infer that at times and under certain circumstances the part of the sheet for a short distance above the grate, and for the greater portion of the distance between the tube and back sheets, marked *C* in Fig. 2, will become hotter than the other portion of the sheet surrounding it; and if hotter then it will be under a strain of compression from the larger and cooled part of the sheet round it. What the difference in the temperature of the part *C* and the balance of the sheet would be under the ordinary working conditions, we have no means of determining; but from the appearance of that part of the sheet, and of stay-bolts in it, in the fire-boxes of coal-burning boilers, it is evident there is, at least at times, a marked difference. The point nearest where combustion is the most active will receive more heat than a point more remote, and as this point is immediately alongside the coal in the process of combustion, it will necessarily receive the most heat, other things being equal. At such times, however, as when the gases evolved from the coal are undergoing combustion in all the space above it, and the combustion is more or less perfect, it is probable that no very great difference in the temperature of the sheet at points above the top of the coal will occur. But by irregular firing, or by throwing the coal on the grate in such a way as to permit the air to be drawn through it in certain spots or holes not far from the sheet, it is evident that great changes of temperature at those particular places will occur, and that such changes will also affect to some extent the part of the sheet nearest to them. While the differences in temperature between different portions of the sheet are only such that the strain brought upon them by the corresponding difference of expansion does not exceed the elastic limit of the metal, no injury is likely to result. Now, if the sheet *D*, Fig. 2, was originally free from strain in all parts of it, and the part *C* from unequal heating becomes of a higher temperature than the part surrounding it, then, as stated before, it will be under a strain of compression, and if the temperature of *C* is further increased above that of the other portion of the sheet until, if free to assume a length through *K L* due to its temperature, it would be ¼ of an inch greater than the other part of the sheet will permit, and the elastic limit of *C* in that direction is but 1-16 of an inch, then *C* will be permanently shortened 1-16 of an inch, or the part of the sheet surrounding it will be lengthened to that extent. But as the part *C* is smaller in section through *I J* than the larger part and the mud-ring to which it is riveted, *C* is much more likely to be permanently shortened through *K L* than that the whole sheet will be elongated in the direction of and through *C H*, in which event *C* will be under a tensile strain in that direction, when the whole sheet becomes uniform in temperature, to the same extent that it was under compression in the former case. But as the elastic limit of *C* is 1-16 of an inch in the direction of *K L*, and as *C* only lost permanently 1-16 of an inch of the ¼ referred to in the first instance, then when the whole sheet becomes cold, or of the same temperature in all its parts, *C* will be under a tensile strain to the extent of what its permanent loss in length was in the first instance, 1-16 of an inch, and equal to the elastic limit of the metal.

Within the limits of the varying temperatures to which a fire-box sheet is subject, the expansion and contraction may be said to observe a uniform rate, being in proportion to temperature.

Experiments made by Fairbairn and others a few years ago demonstrate the fact that the elasticity of steel began gradually to decrease as the temperature was raised above 252 degrees Fahrenheit, or about 100 degrees less than the temperature of the water, with steam at the usual working pressure.

It was also discovered that repeated application and removal of a load which is considerably below the breaking weight of the metal will, after a number of such repeated applications, cause fracture.

If this be true, and if we remember that in the case of steel sheets the load is not only removed but is applied in the opposite direction, by alternate heatings and coolings, the causes that result in rupture would seem to be apparent. If the theory of expansion referred to is correct, then every time a part or spot in a sheet attains a higher temperature than that surrounding it, the metal in it is under a strain of compression; and if that strain is beyond the elastic limit of the metal in that part or spot, it is permanently reduced in area by such compression, and then, when the whole sheet is cold alike, such part or spot is under a tensile strain, so that these alternate forces are constantly produced in the sheets that are unequally heated in their several parts. Steel, as is well known, will bear great tensile strain, and can be elongated to a considerable extent before breaking, provided the strain is confined to one direction, but like iron, will break sooner or later if the strain is applied in alternate directions to an extent closely approaching the limit of elasticity of the metal. For further explanation of the effect of unequal temperature in a sheet, Fig. 3 will illustrate, as between a large sheet and a short one.

E represents a side sheet of a fire-box, with a part immediately above the grate, marked *D*, cut from it, and independent, except at the end *F*, and corresponding with *C*, Fig. 2, the free end of *D* being at the *line B*. Now if we assume that the distance from *B* to *C* is 100 inches, and the temperature of *D* is raised above that of the remainder of the sheet *E* to the extent that the expansion of *D* is 1 unit per inch greater than *E* along *B C*, and that *B* has then reached *a*, then the distance from *A* to *B* will represent 100 units of difference of expansion. Now, if *D* had been attached at *B* so that the movement towards *A* could not have taken place, then the 100 units expansion referred to, would have been absorbed in the elasticity of *D*, between *B* and *C*, under compression. But if the sheet is reduced in length and the distance from *B* to *C* is but 50 inches, then under the former conditions of temperature *B* would move but half the distance towards *A*, or 50 units, and if *D* had been attached at *B* only, the 50 units would be absorbed by the elasticity of *D* under compression. But the extent of compression in the one case, *for each inch in the length of D*, is the same as in the other—1 inch. Now, if *D* is of the same sectional area at all parts of its length, and of equal strength to resist compression and elongation, then the result would be the same, whether the distance from *B* to *C* was 50 or 100 inches. But as numerous stay bolts are situated in *D*, the sectional area across it vertically, through the stay bolts, differs from that between them, and when the greatest strain of compression is exerted in *D* it is the least elastic, and may lose a fraction of its original length on that account. If so, then when cooling off and heating, alternate strains are exerted in turn; and if some one section across *D* is or becomes weak and less able to bear these strains than the other points, then in the case of the long sheet there would be 100 units of elastic force, or a portion of them, that would tend to *accumulate* at such weak points, the same as occurs when compressive or tensile strain is applied to a bar of metal which is smaller at some one point and weaker than at others. If such force is greater than the elastic limit of this weak point, then the whole of the permanent change occurs there—it accumulates there; and as this accumulation in *motion* or *extent* (but not in force) is greater in the case of a long sheet, so is the danger of rupture or injury from expansion and contraction in the part subject to the greatest varieties in temperature—most likely near the vertical center line.

In the use of large vertical sheets in a fire-box, these alternate strains are constantly occurring with the change from the working temperature to that when the boiler is cold, or nearly so, as we have endeavored to show; and it is safe to conclude that these strains in alternate directions (compression and elongation) finally result in the minute cracks so frequently found extending mostly in a vertical direction from the stay-bolts in that part of the sheet subject to the greatest heat.

As previously stated, if the part *C*, Fig. 2 has been overheated, it will be under a tensile strain when cold, or at as low a temperature as the other portion of the sheet, and such strain may be so great as to equal the elastic limit. Now with a tensile strain in the direction of *K L*, Fig. 2, to that extent, and one or more small cracks extending in a vertical direction from one of the stay-bolts situated somewhere near that line, it is not difficult to understand how or why rupture sometimes takes place.

As stated before, we have not heard of a single case where a perfectly clean sheet has ruptured, and from our investigations and observations, we are led to believe that the principal cause which finally results in rupture of the sheet is the formation of more or less scale on the water side of it, preventing the water from coming in direct contact, and as scale is a poor conductor of heat the metal of that part of the sheet represented at *C*, Fig. 2, owing to its close proximity to the intense heat of the coal on the grate, attains a higher temperature than the other portions more remote; and as it cannot assume the proportions due to its temperature the metal is "upset" or shortened while at a high temperature, and when the whole sheet becomes cold then the tensile forces are developed and exert their influence as heretofore explained, and result, ordinarily, in occasional leakage at the stay-bolts situated in that part of the sheet, and sooner or later in developing the small cracks so often found extending from the stay-bolts to the distance of ¼ inch or more in a direction mostly at right angles to the line of strain; and at times, under favorable conditions, result in rupture of the sheet.

The theory that the formation of scale is injurious to the sheet on account of its attaining in that condition a higher temperature than if clean will perhaps not be called in question, and it will account for the fact that rupture occurs so much more frequently in the sheets of boilers in which water is used that leaves heavy deposits of scale than in those in which purer water is used, as was seen in the results on the Northern and that on the Southern Division of the Illinois Central Railroad; and also in the number of ruptured sheets in the fire-box in use on the Western Division of the Pittsburgh, Fort Wayne & Chicago Railway, and that of the Boston & Albany Railroad, where but one steel side sheet ruptured within two years of the 200 in use. The formation of scale in narrow water spaces will doubtless result in injury sooner than where the spaces are wide, permitting a larger body of water and better circulation.

Injurious temperature need not be continued for any considerable length of time to be productive of bad results in a sheet, for the reasons heretofore given. A few minutes will accomplish the same result as if continued for hours.

From the replies to our circulars we learn that a very small proportion of sheets have ruptured in the long and comparatively shallow fire-boxes in which anthracite coal is burned. This may be accounted for from the fact that the sheets are comparatively narrow vertically, and the grates at no very great distance from the crown sheet, and when in working condition there can be no great difference in the temperature of the sheet at the different points between the grate and crown sheet on that account, and if all parts of the sheet are of nearly the same temperature, no such changes from unequal expansion as that referred to in Fig. 2 can occur; therefore the tendency of such sheets to rupture should not be great. On the other hand, we find that rupture is confined almost exclusively to long and deep sheets. The reasons why it is more likely to occur in this class than in the former is the possibility of there being wide differences in the temperature of different parts of the sheet at the same moment. These reasons we have heretofore given, and explained in Fig. 2. The longer the sheet in the direction of the length of the boiler the greater the danger of final rupture, provided the sheet is proportionally deep. We learn from the reports that the different roads have made to us that sheets have ruptured under nearly all circumstances except when the boiler was under steam and with fire on the grate. From the theory advanced above, there ought not to be much tensile strain on the part of the sheet liable to rupture, under this condition, and no case of this kind has come to our knowledge. Rupture has frequently occurred when the sheet was cold, or nearly so, and after cooling down. In answer to the question why it is then likely to take place, we offer this as an explanation. After the water in the boiler ceases to boil, all circulation from that cause ceases, and the coolest water finds its way to the lowest point, on account of its greater density. Now both sheets forming the water space around the lower part of the fire-box are exposed to the air, and as the body of water there is small, it will cool off much faster than above, near the crown sheet, where the body is much greater, and where the outside sheet is covered with a jacket, and as it cools faster at the bottom than at the top, no circulation whatever takes place, and thus a wide difference between the temperature of the water at the bottom of the fire-box and that near the top is likely to occur at each cooling down. The temperature of the sheet, if free from scale, will correspond with that of the water in contact with it; but if covered with heavy scale it will cool faster and be at a lower temperature, and it is the force developed by this difference in temperature between the upper and lower part of the fire-box, added to the tensile strain in the part *C*, Fig. 2, which was previously produced from other causes, that is likely to rupture the sheet. Sheets have ruptured when there was no water in the boiler; but in all cases, so far as we know, it had occurred soon after the water had run out; and if the water was of a higher temperature than the atmosphere at that time, the sheet would cool off in this case much the same as in the former, the upper part cooling slowest, and the result as to additional strains would be of the same character. Filling a boiler with water of a lower temperature than the metal of the sheets has produced rupture in a large number of cases, and is the result of the contraction of the metal through *K L*, Fig. 2, when the water reaches and cools it, while the part through *G H L* is still at a higher temperature.

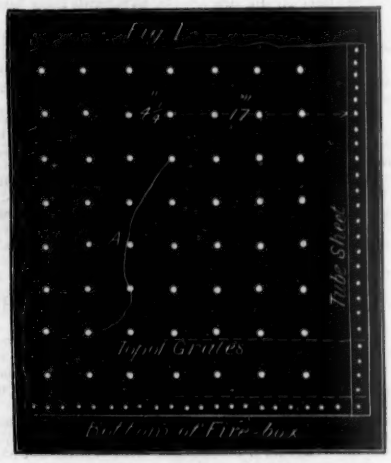
Several cases have been reported where rupture occurred after starting a fire in the engine, and before steam was raised.

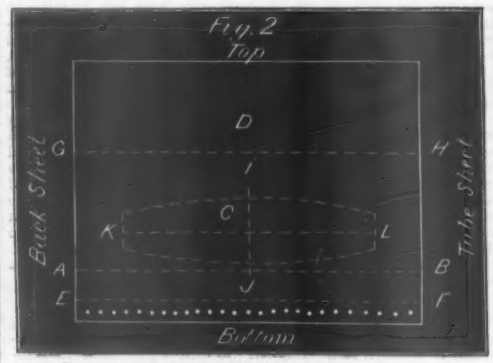
Now it should seem that if the metal along *K L* was under tensile strain in that direction previous to starting a fire, that the heat imparted to it immediately afterward would commence to relieve that strain, and that rupture of the sheet could not occur under such circumstances. One of your committee made some experiments a short time ago to determine the effect of heat applied to the outside of the sheet in heating the water in the water space, as regards the temperature of the water at different points between the bottom and top, during the time the water was being heated to the boiling point. A water-space was constructed 2¼ inches inside, 10 inches high, 14 inches long. The sides were of 1-16 in. sheet iron, and the ends between the sheets were made of plate glass ½ of an inch thick. This water space formed one side of a square iron box, having a chimney on top and grate in the bottom, the top of the grate bars being 1 inch above the bottom of the waterspace. This space was filled with water at a temperature of 50 degrees. A thermometer was introduced into the water-space attached to a wire, so as to be raised or lowered in the column of water when desired, the glass ends of the water-space admitting the reading of the thermometer at any point in the height of the column. The water-space occupied the same position in this iron box as in the side of any ordinary fire-box. A charcoal fire was built in the grate, and after a few minutes the thermometer, with the bulb in a line with the grate, showed a temperature of 55 degrees, and being raised with the bulb just under the top of the water showed a temperature of 80 degrees, and when the temperature at the top of the grate was raised to 60 degrees, and after reaching 120 at the bottom, the temperature at the top was 180 degrees. The temperature at the intermediate points between the top and bottom showed a gradual increase from the bottom upward in proportion to distance.

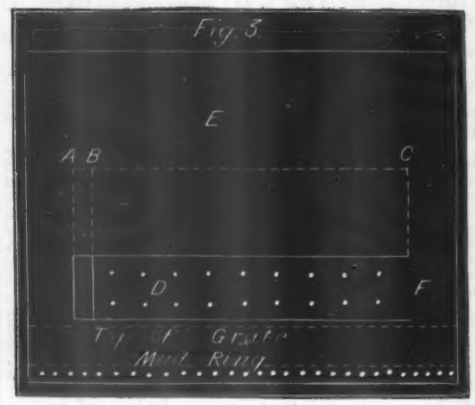
As soon as the water commenced to boil in the upper part of the water-space, the temperature at the bottom rose rapidly to the boiling point.

Several tests were made in heating the water from 50 degrees to the boiling point, with results varying but little from that given.

From these tests we learn that after a fire is started on the grate the temperature of the water in the upper part of the water-space increases more rapidly than that at the bottom,







and that the difference is at certain times as much as 60 degrees.

Now, this difference of temperature between the upper and lower part of the sheet produces the same results, as affecting the previous tensile strain in the direction of *K L*, Fig. 2, that is produced by cooling down, or by putting cold water in the boiler while the sheet is at a higher temperature than the water; and if rupture can be produced in the latter cases it may also in the former.

In cooling down there was not so marked a difference between the temperature at the top of the water and at the bottom. The water-space being open at the top and exposed to the air, the temperature there would naturally fall faster than under the circumstances that exist in a boiler. A test with the thermometer, however, showed that when the temperature of the water was 122 degrees at the top, the temperature at the bottom was 114. With two exceptions, in all the cases of ruptured sheets reported, not one is mentioned in which the crack took a horizontal direction. Some have been diagonal a part or all of the distance, but none horizontal. This may be accounted for from the fact that the line of greatest heat extends entirely around the fire-box, parallel with the grate, and is doubtless a comparatively narrow section compared with the total distance between the grate and crown sheet. Therefore the temperature on any one line around the fire-box, at a given height above the grate, will not greatly vary, except that it will probably be less in the corners than on a line up the centres of the sheets, and strains produced from unequal vertical expansion of the sheets cannot be of such magnitude as to cause rupture on a horizontal line. Yet in the portion of the side sheets, represented at *C*, Fig. 2, and also a corresponding portion in the end sheets, they will, when cold, be under a tensile strain in the direction of *I J*, which was originally produced by the same causes that produced that in the direction of *K L*, but of less proportions for reasons given above. But if the temperature of the sheets at the corners of the fire-box always corresponded with that on a line at the centres of the sheets, no vertical strain whatever could be produced in any part of the sheet. It is only to the extent that the temperature of the corners differs from that along the centre of the sheet that any vertical forces can be produced.

Now if rupture occurs at some point along *K L*, Fig 2, from strain in that direction, the crack will be vertical in direction its entire length, if no force is exerted in the direction of *I J*. But if the metal is under a tensile strain in that direction also, the crack will take a diagonal direction, corresponding with the extent of two forces.

As previously stated, all cases of rupture coming to our knowledge had their origin in some one or more small crack at a stay bolt, and from this beginning, when the sheet was under great tensile strain, the crack starts, and when once started what is known as the "heaving process" comes into play—one particle of the metal after another giving way in succession, yet all being done instantly—extending the crack beyond where the forces were sufficiently great to *initiate* a crack.

To explain why one sheet cracks and many others used under precisely the same circumstances do not, would be as difficult as to explain why one leaf of a spring made from the same bar as the others, and tempered, tested and used precisely the same as all the others, and the same as those in many other springs like it, breaks, and yet none of the others do. There is doubtless a difference in some respects that it might be impossible to discover.

A reasonable, and, as we believe, a correct answer to this question is, that the metal in *C*, Fig. 2, is gradually reduced in area to a slight extent, principally in the direction of *K L*, from the causes heretofore explained, but still remains of such area that when the sheet is at its usual working temperature it is under some strain of compression while the part around it is under the opposite strain. The metal being elastic, to a certain limit, *C* is slightly compressed and *D*, Fig. 2, elongated, and when cold *C* is elongated and *D* (or the remainder of the sheet) is compressed, the result of each in its efforts to accommodate itself to the forces or influence of the other; and that ordinarily these forces so adjust themselves that they remain under all the circumstances of varying temperature much within the elastic limit of the metal, and in this condition they may be continued indefinitely without injurious results.

From our investigation of the causes that often result in rupturing the large sheets of fire-boxes, we conclude that some form of corrugation of that part liable to the destructive forces referred to will be most likely to be successful in preventing it. Such corrugations need not extend perhaps more than 30 inches above the grate to answer the purpose intended. We think it possible that four or five slight vertical channels between the alternate rows of stay-bolts, in the side sheets, will be found equally effectual.

It is the tensile force only that results in rupture, or, ordinarily, what is nearly as bad, in small cracks at stay-bolts, and more or less leakage there; and if we provide a relief for that strain when it exerts its force, then rupture or injury to the sheet cannot occur, and the form of the sheet at part *C*, Fig. 2, that will relieve a tensile strain in the direction of *K L* will also relieve that of compression in the same direction. As rupture, or injury at stay-bolts, occurs in no other part of the side sheet than in the part *C*, Fig. 2, it would seem to be unnecessary to provide relief for these strains in any part, and the several slight channels or corrugations referred to above crossing this part *C* vertically, between the rows of stay-bolts, with the channel in the water side of the sheet, should by the springs of the curve of the corrugations relieve indefinitely all strains produced by unequal expansion or contraction, without any danger of rupture or injury to the sheet. Such corrugations need not, perhaps, be more than the thickness of the sheet in depth, beginning gradually and ending the same; and if properly annealed, the sheet will be left entirely free from the strain developed in corrugating it, and of a form to be easily fitted to the other parts of the fire-box, and curved as may be desired.

TO BE CONTINUED.

Sudden Desertion of Enginemen.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Will the Brotherhood sustain them? The following-named engineers, all Brotherhood men, deserted their engines on Monday, May the 8th, on the Rockford, Rock Island & St. Louis Railroad, without any notice being given of their intentions. The most of them had left town Sunday night previous:

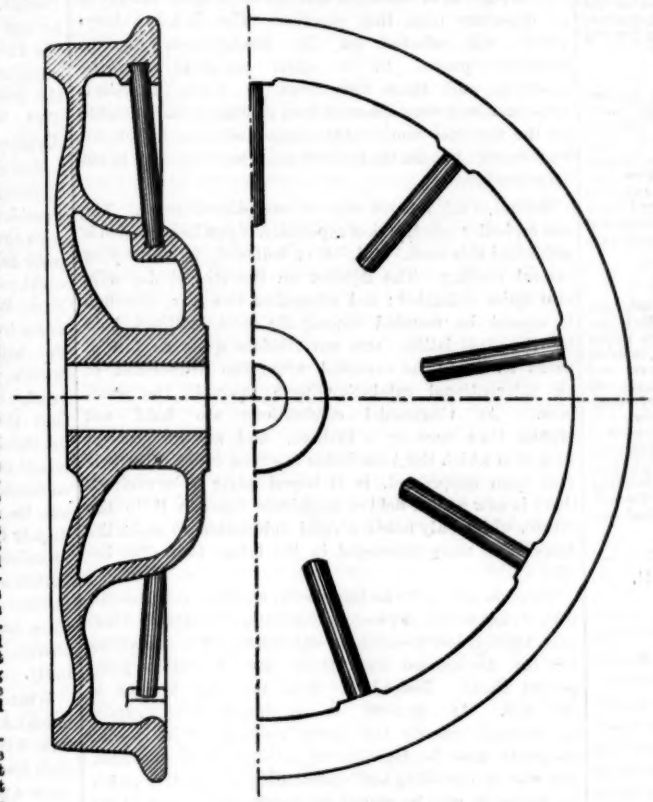
Gray,	Weaver,
Rogers,	Devlin,
Bailey,	Gough,
Fezln,	Toombs,
Kavanaugh,	Lucas,
Cowan,	Manny,
Henderson,	Webb,

all of the passenger runners and five of the freight men, thereby hindering and delaying the trains. It is generally supposed by railroad officials that the purpose of the Brotherhood of Engineers was for the better protection of the regular engineers, also to protect railroad managers against what are known as "scabs." If this is the treatment railroad managers are to receive at their hands, they had better be careful in employing Brotherhood men. If these engineers had any grievances they were not made known to the managers of the road. What has the Brotherhood to say in this matter? WESTERN.

[We have heard nothing of the causes of this act; but in these days, when it is so extremely difficult for men to get an engine when once out of work, it is reasonable to suppose that the men had, or supposed they had, very serious grievances, even assuming that they had not the slightest sense of duty to their company.—EDITOR RAILROAD GAZETTE.]

New Car Wheel.

The illustration herewith represents a new pattern of cast-iron car wheel now manufactured by the Lobdell Car Wheel Company of Wilmington, Del. The peculiarity of the wheel is the addition of wrought-iron arms in the back of the wheel, as represented in the engraving. These are made of bars of round iron, and are cast in the wheel, one end being fastened in the rim and the other to the inside plate. The whole construction is shown so clearly in the engraving that further description is unnecessary.



NEW CAR WHEEL,

Manufactured by the Lobdell Car Wheel Company.

ELECTIONS AND APPOINTMENTS.

Missouri, Kansas & Texas.—At the annual meeting in Parsons, Kan., May 17, the following directors was chosen: H. C. Cross, Emporia, Kan.; B. P. McDonald, Fort Scott, Kan.; C. H. Pratt, Humboldt, Kan.; W. M. Gentry, Sedalia, Mo.; Erastus Corning, Albany, N. Y.; J. L. Agnew, John Elliot, Shepard Gandy, H. A. Johnson, N. L. McCready, Henderson Moore, Elisha Riggs, Francis Skiddy, New York. The new directors are Messrs. Gentry, Elliott, Gandy, Johnson, Moore and Skiddy, who replace R. E. Carr, Adolphus Meier, T. J. Bartholemew, Wm. H. Guion, George Bliss and H. C. Dickinson. Messrs. Skiddy, Gandy and Johnson, however, were directors up to last year. It is understood that Mr. Riggs will be President.

Central Vermont.—The list of directors chosen at the annual meeting, May 17, as given by telegraph last week, was incomplete and somewhat incorrect. A corrected list of the new board is as follows: J. Gregory Smith, Worthington C. Smith, Bradley Barlow, St. Albans, Vt.; B. B. Smalley, Burlington, Vt.; Frederick P. Clark, Milton, Vt.; Luke P. Poland, St. Johnsbury, Vt.; James B. Langdon, Montpelier, Vt.; J. H. Kimball, Bath, Me.; George M. Rice, Worcester, Mass.; B. P. Cheney, Jacob Edwards, James W. Emery, Boston; J. Q. Hoyt, New York. There was no opposition.

Detroit, Lansing & Lake Michigan.—Mr. Charles L. Young, of Boston, has been appointed one of the trustees under the first mortgage, in place of Stephen V. R. Thayer, deceased.

Georgia.—At the annual meeting in Augusta, Ga., May 11, Mr. John P. King was re-elected President, with the following directors: E. E. Jones, James W. Davies, James S. Hamilton, Stevens Thomas, M. P. Stovall, George T. Jackson, L. M. Hill, Josiah Sibley, D. E. Butler, George Hillyer, John Davidson, Wm. M. Reese, Wm. W. Clark, Charles H. Phinzy, John H. James, F. H. Miller. The board re-elected Col. S. K. Johnson Superintendent. The only change in the board is the substitution of F. H. Miller for Anthony Poullain, who declined re-election.

Cincinnati, Hamilton & Dayton.—At the annual meeting in Cincinnati, May 16, the following directors were chosen: F. H. Short, George T. Steadman, H. D. Huntington, Henry Lewis, Joseph H. Rogers, Oliver Perrin, Samuel Fosdick, Rufus King, L. B. Harrison. The board re-elected F. H. Short, President; George T. Stedman, Vice-President; C. B. Marsh, Secretary and Treasurer; L. Williams, Superintendent.

Cincinnati Southern.—The Superior Court has appointed John Schiff a trustee, in place of Alphonso Taft, resigned.

Pittsburgh, Fort Wayne & Chicago.—At the annual meeting in Pittsburgh, May 17, the four directors whose terms had expired were re-elected, as follows: G. W. Cass, J. N. McCullough, Pittsburgh; J. F. D. Lanier, Samuel J. Tilden, New York.

St. Louis, Rock Island & Chicago.—The officers of this new company, successor to the Rockford, Rock Island & St. Louis, are as follows: President, Heyman Osterberg, Rock Island, Ill.; Vice-President, W. C. Brewster, Davenport, Ia.; Treasurer, J. M. Gould, Moline, Ill.; Secretary, Walter Trumbull, Rock Island, Ill.; General Manager, George Skinner, Rock Island, Ill. The general offices of the company will be at Rock Island.

Railway Purchasing Agents' Association.—At the annual meeting in Cincinnati, May 18, the following officers were chosen: President, J. T. Sterling, Toledo, Wabash & Western; First Vice-President, A. C. Armstrong, Lake Shore & Michigan Southern; Second Vice-President, Allan Bourn, Michigan Central; Secretary and Treasurer, A. G. Thompson, St. Louis & Southeastern; Executive Committee, W. S. Cuddy, St. Louis, Iron Mountain & Southern; J. T. Crocker, Chicago, Milwaukee & St. Paul; E. W. Porter, Canada Southern; G. C. Breed, Louisville & Nashville; J. H. Holway, Atlantic & Great Western.

Manchester & Keene.—At the annual meeting in Keene, N. H., May 17, the following directors were chosen: Theodore H. Wood, Nashua, N. H.; Ansel Dickinson, Manchester, N. H.; Milan Harris, Harrisville, N. H.; Christopher Robb, Stoddard, N. H.; Daniel H. Goodell, Antrim, N. H.; Gilbert Wadleigh, Milford, N. H.; Henry Colony, George B. Twichell, James L. Bolster, Edward Gastine, Keene, N. H. The board elected Theodore H. Wood, President; Thomas E. Hatch, Clerk; S. G. Griffin, Treasurer.

Houston & Texas Central.—At the annual meeting in Houston, Tex., recently, the following directors were chosen: Abram Groesbeck, Wm. R. Baker, F. A. Rice, A. S. Richardson, A. A. Van Alstyne, Cornelius Ennis, Houston, Tex.; John I. Blair, Blairstown, N. J.; Wm. E. Dodge, Wm. M. Rice, John J. Cisco, Moses Taylor, New York. Messrs. Blair and Richardson are new directors, replacing A. J. Burke and Wm. J. Hutchings. The board re-elected Wm. E. Dodge, President; A. Groesbeck, Vice-President; A. S. Richardson, Secretary; F. A. Rice, Treasurer; Cornelius Ennis, Financial Agent; W. R. Baker, F. A. Rice and A. S. Richardson, Executive Committee.

East Line & Red River.—The new board of directors is as follows: W. M. Harrison, B. H. Epperson, E. W. Taylor, W. B. Ward, J. H. Bemis, W. Q. Bateman, L. A. Ellis, J. P. Russell, S. D. Rainey. The board has elected W. M. Harrison, President; E. W. Taylor, Vice-President; W. B. Ward, Treasurer. The office is at Jefferson, Tex.

Dallas & Wichita.—Mr. W. H. Gaston, of Dallas, Tex., has been chosen President.

Pekin & Mississippi.—At the annual meeting in Pekin, Ill., last week, the following directors were chosen: P. Weyrich, E. Richards, H. W. Hippen, Pekin, Ill.; Wm. Parlin, Canton, Ill.; H. Wilson, Fairview, Ill. The board elected officers as follows: President, Ed. Richards; Vice-President, Wm. Parlin; Secretary, D. C. Smith; Treasurer, Peter Weyrich.

National Railway Publication Company.—This company, which publishes the *Official Railway Guide*, has re-elected Henry W. Gwinner, President; Edmund Allen, Secretary; E. T. Sees, Treasurer; W. F. Allen, Editor.

New York Central & Hudson River.—Mr. Daniel McCool, late Resident Engineer, has been appointed Assistant Superintendent Western Division.

Chesapeake & Ohio.—Mr. M. S. McCoy has been appointed Traveling Passenger Agent. He was for a long time connected with the Baltimore & Ohio.

THE SCRAP HEAP.

Railroad Manufactures.

The Hinckley Locomotive Works in Boston are building two 33-ton freight engines for the Boston & Lowell road.

The Watson Manufacturing Company has recently put up combination (wood and iron) bridges over the Trinity, Neches and San Jacinto rivers on the Texas & New Orleans road. The two first-named have draw spans wholly of iron.

The Indianapolis Rolling Mill has begun work on a contract to reroll 1,000 tons of rails for the Terre Haute & Indianapolis road.

Jones & Co., of West Troy, N. Y., have an order for street cars to go to Jamaica, West Indies.

The Roane Iron Company's mills at Chattanooga, Tenn., are running full double turn and have a number of orders for rails to fill.

The Rome Iron Works at Rome, Ga., have been leased to the Bartow Iron Company and will shortly start up, making bar iron and nails.

The Topton Iron Company has sold its furnace at Topton, Pa., to Jacob Huntzinger, of Pottsville.

The Jackson & Sharp Company at Wilmington, Del., has recently turned out four first-class passenger cars for the New Jersey Southern Railroad.

Messrs. W. H. Baily & Co., of the National Locomotive Works at Connellsville, Pa., have made arrangements to run one of their standard narrow-gauge locomotives on the railroad within the Centennial grounds at Philadelphia, with the purpose of showing those interested something of the performance of their engines. The engine has 11 by 16-inch cylinders, drivers 44 in. in diameter, and is of their usual make, without extra finish or ornament.

The New Haven Car Company at New Haven, Conn., is building four passenger cars for the New Jersey Midland.

Ejecting Gamblers from Trains.

In a suit brought by one Thurston, a gambler, who was ejected from a car on the Union Pacific road on account of his known profession and in accordance with standing orders to trainmen, the United States Circuit Court at Omaha has refused to give damages, and the man received merely a verdict for $1.47, the amount which he had paid for a ticket. The result of the case indicates that companies have the right, for the protection of passengers, to eject gamblers from their trains, being merely required to refund the fare paid by them.

A Railroad Sleeper that Served 42 Years.

In the lobby of the Boston & Providence station at Boston is exhibited a stick of timber about 6 feet long. The outside is decayed and apparently its original proportions are considerably reduced by decay; but most of the stick is still sound. It bears the following inscription: "This old Red Cedar sleeper was laid in the Boston & Providence Railroad track November, 1834, and has just been removed. It was cut on the John C. Dodge estate in the town of Attleboro. The tree furnished two sleepers."

RAILROAD GAZETTE

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S. WRIGHT DUNNING AND M. N. FORNEY.

CONTENTS.

Editorial Announcements.

Passes.—*All persons connected with this paper are forbidden to ask for passes under any circumstances, and we will be thankful to have any act of the kind reported to this office.*

Addresses.—*Business letters should be addressed and drafts made payable to* THE RAILROAD GAZETTE. *Communications for the attention of the Editors should be addressed* EDITOR RAILROAD GAZETTE.

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies, the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and in their management, particulars as to the business of railroads, and suggestions as to its improvement. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

THE MASTER MECHANICS' CONVENTION.

The annual meeting of this Association this year somehow has not furnished much material or occasion for comment. Doubtless this was due to the overshadowing influence of the International Exhibition. Nearly every one anticipated that the interest of the latter would absorb much of the zeal of the members on the subjects which usually occupy the attention of the Association. This fact was recognized by the officers at the beginning, and steps were taken to condense the proceedings into as short a time as possible. On the first day the meeting was called to order promptly at 10 a. m., and it was then resolved to hold two sessions each day, one of them from 9 a. m. to 1 p. m., and the other from 2 to 5 p. m. This plan was carried out, and most of the members in attendance remained faithful to their duties during these hours. By Wednesday afternoon it was apparent that the business would be completed that day, and before 5 o'clock there remained nothing more to be done, and the convention adjourned.

The attendance of members this year was smaller than usual, and was probably less than one hundred, although no accurate count was possible, as many did not answer the roll call and some stayed with their friends in and out of the city. There was, however, an evident disinclination to extend the debates, and therefore it will be seen that these occupy much less room than they ordinarily do. Considering the interest felt in the Exhibition, this was perhaps to be expected this year; but the same tendency was observable, although due to other causes, in previous meetings. We are inclined to believe that the usefulness of the Association is somewhat injured by this, and that, instead of aiming to curtail discussion, if an effort was made to elicit a freer expression of opinion, and a fuller narration of practice and experience, the value of the proceedings would be increased. The training of persons engaged in the practical affairs of railroad management is of such a character as to lead them to "push things through." Now in deliberating on a subject this is usually the very worst thing that can be done. The object to be accomplished in bringing a subject before a deliberative body is not simply to take a vote on it, but it is to learn how to vote in the most intelligent and wisest way; and to do this the matter should be turned over, as it were, in every possible position, and be presented by each member as it appears to him. This should be done deliberately and without hurry, and every encouragement should be given to those having any information relating to the subject to give it. Long-windedness and tedious prolixity should, of course, be avoided, as far as possible, but these are not besetting sins of master mechanics. The plan of setting apart a certain hour of each day for hearing and discussing questions relating to the construction or operation of railroad machinery, which has been adopted in some kindred associations, was proposed by Mr. Robinson, of Canada. This undoubtedly would excite a great deal of interesting discussion, and would probably direct the attention of members to subjects which would never be thought of by the committee appointed annually to prepare a bill of fare for the following year. The plan is well worth a trial; it can easily be abandoned if it does not work satisfactorily.

Most of the real friends of the Association were this year gratified at the total absence of all public entertainments of the members. This practice had become so obnoxious to many master mechanics and their superior officers that some of the ablest men in the country were never seen at the meetings. The Committee of Arrangements had the wisdom and good taste this year to do absolutely nothing, except to secure for the meeting the hall of the Franklin Institute, which is admirably suited for that purpose. Their course was commended by all the members, and the wish seemed to be universal that hereafter there should be no departure from that practice. The Hotel Aubrey, which was selected for the headquarters of the members, proved to be quite adequate for the occasion, and there was room to spare. Doubtless some members were deterred from coming to Philadelphia by the fear that comfortable accommodations could not be secured; but for the present at least that city is not overcrowded.

Several of the reports were of exceptional value. The one on boiler construction especially, a portion of which is published this week, will, it is believed, be worthy of careful reading. The debates on the second day were also quite animated; and altogether this year, although it cannot be counted among the most brilliant held by the Association, was nevertheless quite as full of profit as could be expected when the attractions of an international exhibition were open to the members. As Centennial celebrations are held not oftener than once in a lifetime, and as the greatest danger to which the Association has been exposed has this year been suppressed, it is hoped never to be revived, there is now a clear field of usefulness open to it in the future, which only needs careful cultivation to make the Association more successful in the future than ever before.

There seems to be an impression among some persons, that, owing to the depressed condition of railroad business, there is less occasion or opportunity for usefulness for the Association than there was in more prosperous times. Instead of this, the very reverse is the fact. At present it is hopeless to expect to increase greatly the gross receipts of railroads; the profit must be derived from a reduction of expenses. The cost of operating and maintaining the motive power on railroads may be stated in round numbers at 20 per cent. of the whole operating expenses, and the maintenance of cars at 10 per cent., so that 30 per cent. of the total expenditure of operating railroads is made under the direction of the machinery departments. Master mechanics may expect, if they have not already heard, much more earnest inquiries than ever before as to where this money goes. Such inquiries the Master Mechanics' Association ought to be prepared to answer, and also to suggest how the cost of moving freight and passengers may be diminished.

TEXAS RAILROAD MOVEMENTS.

The Texas & Pacific Railway Company will, we understand, immediately complete the extension of its main line to Fort Worth, 33 miles west of the Texas Central crossing at Dallas, lay the track on the gap from Texarkana west to Brookston, so as to complete the Transcontinental Division from its eastern terminus to the Texas Central crossing at Sherman, and within a short time begin the extension of this Division from Sherman southwest to the Main Line at Fort Worth, completing the loop. When this is done the company will have a complete system of lines inclosing a space about 170 miles long from east to west and about 60 miles wide from north to south, most of it in a fertile country, producing grain as well as cotton, with abundance of timber fit for lumber on the eastern part and fertile prairies to the west, and, what is perhaps most important in the present condition of Texas traffic, extending a little further west than the territory which is much cultivated. The importance of passing by the cultivated districts, such as border the Houston & Texas Central road for most of its length, is due to the cattle traffic. A great trail cannot be maintained through a thickly peopled and well-cultivated district, for two reasons, one being the lack of the wide ranges needed for pasturage on the drive, the other the damage which the wild cattle do to the cultivated fields and the consequent opposition of the farmers, which sometimes manifests itself very vigorously, attended by the use of fire-arms. By extending the railroad beyond the settlements, a comparatively clear path to the great cattle-growing regions of Western and Southwestern Texas is struck, by which cattle may be driven to a railroad station nearly as freely as they are now driven three hundred miles farther north to the Kansas railroads. There are, we believe, few points on the Houston & Texas Central Railroad easily reached by a cattle trail; and the population and production of exportable products on the line of this well-placed road are so great that probably it would not favor the establishment of such a trail. Heretofore, we understand, the chief shipments made direct by rail from Texas have been either from points on the Galveston, Harrisburg & San Antonio Railroad, which must reach San Antonio (as it is to do this year) before it has a clear route to the cattle; or from Denison, close to Red River, at the southern terminus of the Missouri, Kansas & Texas road, whither the cattle are driven from the Southwest. Those coming from the San Antonio road have generally taken the Iron Mountain route, which they reached by way of the International & Great Northern road; while the only route open to the Denison drives is the Missouri, Kansas & Texas. The Texas & Pacific, by its extension to Fort Worth, will be able to intercept these Denison drives, while by the completion of the Transcontinental Division to Texarkana it will be in position to compete with the Missouri, Kansas & Texas for the droves which may continue to come further north than Fort Worth—Sherman, the western terminus of this division, being but nine miles from Denison.

According to the bill introduced in Congress by Mr. Throckmorton, of Texas, (recently an officer and formerly President of the company, who may be supposed to act with the company's authority) the Texas & Pacific Company has the time for the completion of its road extended eight years *on condition* that it complete the extension to Fort Worth and the Transcontinental Division from Paris to Texarkana within a year from the passage of the bill, and 50 miles from Sherman towards Fort Worth the following year, and shall build 20 miles yearly on the Pacific end of the line. This indicates that the company is prepared to do some work immediately, without help from the Government; and the report of earnings for the year ending with March last is so favorable that it is reasonable to suppose that capital can be obtained for such extensions as will add immediately to the amount of traffic, as that to Fort Worth promises to do. The net earnings for this year are reported at $2,050 per mile, which is sufficient to pay good interest on what it would cost to construct the road at this time, and is about a fifth more than the present interest charge. The interest due June 1 is to be paid, accordingly.

Whatever cattle traffic this road may secure will be so much added to the business of the St. Louis, Iron Mountain & Southern, which is now the only eastern outlet of both lines of the Texas & Pacific. It will also probably cause a more lively competition between that company and the Missouri, Kansas & Texas; though really the most formidable competition, so far, of both rail routes has been the free drive by the trail to Kansas, which has made it necessary to accept low rates on the through railshipments or abandon this traffic entirely.

By the announcement, made last week, of the change of gauge to be made next August on the sole Gulf outlet of the Texas system of railroads—the Galveston, Houston & Henderson—and of the main line of the most important Texas railroad, the Houston & Texas Central, it will be seen that before the end of this summer the Texas railroads, with the exception of the Austin Branch of the last-named road, on which the 5 ft. 6 in. rolling stock can be worn out, will be of the standard Northern gauge—4 ft. 8½ in.; which fact will probably compel the adoption of that gauge at an early day by all the other roads west of the Mississippi, and first of all by the Iron Mountain road. This road some years ago changed from 5 ft. 6 in. to 5 ft. to complete a connection with the Southern system east of the Mississippi, then its only Southern connections. This change brought it a large traffic, which at first was profitable. But since that time the other Northern connections of the 5-ft. system have been multiplied and improved, so that the Iron Mountain no longer gets so large a proportion of it, and, worse than all, the competition is so fierce that there is little profit on what it does get; while the Texas system during the same period has been created for the most part, and its connection with the North completed. Already, we understand, the Texas traffic has become the most important through business of the Iron Mountain road, and moreover this is a growing business, while that of the country east of the Mississippi does not increase. The Texas traffic is not now very large, so that

the transfer is not yet a great obstacle; and moreover it consists largely of cattle, which have to be unloaded every twenty-four hours any way; but then the Missouri, Kansas & Texas already offers the advantage of an unbroken gauge, and the Iron Mountain on this account will probably be inclined to hasten the time of the change wh ch seems unavoidable.

Probably the line from Memphis to Fort Smith will next adopt the standard gauge, when the 5 ft. system will be hemmed in on all sides. It seems probable that it too will soon be compelled to change, though the time may be long delayed, and the Mississippi on the West and the Ohio on the North may for many years continue to be the boundaries between the two gauges.

Diverting Grain Traffic from Lake to Rail.

The grain movement as shown by the reports for all the northwestern markets for the week ending May 13 enables us to continue the comparisons made last week.

The receipts at these markets for three weeks, including the period since the opening of navigation, have been, for two years:

Week ending—	1876.	1875.
April 29	3,210,437	3,392,287
May 6	3,055,911	2,735,247
May 13	2,302,046	2,536,560
Three weeks	8,568,394	8,664,094

Thus the stimulation caused by low rates seems not to have extended to the primary carriers—those which receive from the farmers and carry to the first market. The total receipts at these markets since January have been 10 per cent. more than last year; but for the three weeks in question they are a trifle less.

The shipments from these markets for the same period, by lake and rail, were:

Week ending—	By Lake.	By Rail.	Total.	P. c. by rail.
April 29	1,634,541	2,072,946	3,707,487	56
May 6	2,445,191	2,292,633	4,737,824	48½
May 13	1,538,526	2,302,940	3,841,466	60
Three weeks	5,618,258	6,668,519	12,286,777	54¼

What is especially notable here is that the rail shipments have increased, though the total shipments for the last week reported decreased largely. The rail movement was no less than 60 per cent. of the total, having been the previous year (with a large rail movement) 35½ per cent. for the corresponding week, and in 1874 23¾ per cent. The total shipments continue large, for the week ending May 13 being 10½ per cent. greater than for the corresponding week of 1875.

The shipments, however, very largely exceed the receipts. For the three weeks reported, shipments were 12,297,000 bushels; receipts, 8,568,000. At the close of the period the stocks on hand at these markets were less than 12 days' shipments at the rate of the last week reported.

The shipments for the three weeks since navigation opened can hardly be called extraordinarily large, however, as will be seen by a comparison of the amounts shipped from the markets in question for the corresponding periods for four years, as follows:

April 22 to May 13:	1876.	1875.	1874.	1873.
Bushels shipped	12,286,777	7,695,816	12,285,353	11,309,471
Bushels shipped by rail	6,668,519	3,775,171	2,980,406	2,915,518
" " " lake	5,618,258	3,920,645	9,304,947	8,393,953
Percentage by rail	54¼	49	24¼	25¾

Thus it appears that this year's total shipments for the three weeks, though 64 per cent. greater than last year, were almost the same as in 1874, and not 9 per cent. more than in 1873. Thus, as we have said before, the low rail rates seem not to have had much effect in increasing shipments, but only the effect of diverting shipments from the water to the rail route. This effect they have certainly had in a marked degree. With total shipments the same as in 1874, lake shipments are 40 per cent. less; rail shipments 126 per cent. greater; the railroads have carried 3,688,000 bushels more, the vessels 3,687,000 bushels less. Hardly anything could be more conclusive as to the ability of the railroads to divert the grain traffic to themselves by making rates low enough, and that with such water rates as prevailed down to the 13th of May the prevailing rail rate of 20 cents a hundred from Chicago to New York was low enough for this purpose. So much seems to be pretty well demonstrated.

With regard to the effect on the receipts of the different Atlantic ports, the disturbance of which was assigned by the New York Central as a reason why it could not abide by the rates and differences in rates maintained during the winter and early spring, an examination of the returns as given by the *Produce Exchange Weekly* will enable us to judge.

For the eleven weeks from March 5 to May 13 the receipts of all kinds of grain and the percentage of receipts of each port were as follows:

	Bushels.	Per. cent. of total.
New York	9,574,040	35.9
Boston	2,133,298	8.0
Portland	890,682	3.4
Montreal	540,589	2.0
Philadelphia	6,221,375	23.4
Baltimore	5,782,659	21.8
New Orleans	1,444,608	5.5
Total	26,587,221	100.0

For the six weeks immediately preceding the break of rates, that is, from March 12 to April 22, the receipts of these ports were:

	Bushels.	Per cent. of total.
New York	3,743,476	33.0
Boston	934,178	8.2
Portland	565,560	5.0
Montreal	175,165	1.5
Philadelphia	2,468,950	21.7
Baltimore	2,797,194	24.6
New Orleans	688,185	6.0
Total	11,372,708	100.0

Now for the three weeks after the break of rates, navigation being open for two of the weeks, and the rail rates from Chicago being usually 20 cents to New York, 18 to Philadelphia and 17½ to Baltimore, the receipts were:

	Bushels.	Per ct. of total.
New York	4,164,108	42.2
Boston	833,992	8.4
Portland	199,510	2.0
Montreal	335,494	3.4
Philadelphia	2,395,400	24.3
Baltimore	1,552,125	15.7
New Orleans	400,766	4.0
Total	9,881,395	100.0

Putting the figures for the percentage of total seaboard receipts received at each port side by side for the period immediately preceding and that immediately succeeding the great reduction in rail rates, one may perceive what has been the effect of this reduction, *plus that of the opening of navigation*, which is doubtless quite as important. This is done below:

	Before April 22.	After April 22.
New York	33.0 per cent.	42.2 per cent.
Boston	8.2 "	8.4 "
Portland	5.0 "	2.0 "
Montreal	1.5 "	3.4 "
Philadelphia	21.7 "	24.3 "
Baltimore	24.6 "	15.7 "
New Orleans	6.0 "	4.0 "
Total	100.0 per cent.	100.0 per cent.

Here we see that New York and Philadelphia have increased their proportions of the receipts, while the proportion of Baltimore has fallen off to just about the extent that New York has gained. Baltimore, indeed, has received not only a smaller proportion, but absolutely less than for corresponding periods in March. In that month the receipts at that place were an average of 633,000 bushels weekly; for the next three weeks they were 328,000 weekly; and since the break in rates and the opening of navigation they have been but 517,000 per week.

It is further noticeable that the Baltimore receipts continue to be almost exclusively corn. But while its corn receipts (with its other grain receipts) have actually decreased, those of New York and Philadelphia have nearly doubled. Philadelphia could not benefit by the opening of canal navigation and not so much as New York by the opening of lake navigation; but its total receipts, which for six weeks before April 22 had been 420,000 bushels per week, for the three weeks after were nearly 800,000 bushels per week.

On the whole, it is not possible to say positively that any of the changes above indicated have been occasioned by the reductions in rail rates. New York has gained most, and Baltimore has lost; but Baltimore depends exclusively upon the railroads, and New York has profited by navigation on both lakes and canal. Philadelphia, which has gained, but not so much as New York, has some advantage from the lake navigation.

Foreign Railroad Notes.

The Standing Committee of the Congress of Economists have decided to present for discussion at the meeting in Bremen, Sept. 26 to 28 of this year, the question now hotly debated throughout Germany, of the purchase of the German railroads by the Empire. Dr. A. Meyer, General Secretary of the German Commercial Congress, is appointed to report for the side in favor of the purchase, and Dr. Victor Boehmert, of Dresden, Saxony, is to report on the other side. Dr. Boehmert has begun his task by writing to the *Journal* of the German Railroad Union a quite long article in which he sets forth a summary of the objections to the purchase as they now appear to him, "in order," he says, "to purify them before the session of the Congress by public criticism," and he invites criticism, records of home and foreign experience and suggestions, in order that his report next September may be so far as possible exhaustive on that side of the subject. Americans who have anything to offer may address Dr. Boehmert at Bergstrasse 66, Dresden.

With regard to this purchase, it should be borne in mind that the only thing actually proposed, so far, is the transfer of such of the Prussian railroads as are owned or worked now by the Kingdom of Prussia to the Empire of Germany, and with them the authority to regulate the private railroads now possessed by the Kingdom. But it is universally understood that this is to be only the first step in a policy which will in due time cause the Empire to absorb at least all the railroads now owned by the States belonging to the Empire. Bavaria owns all its railroads; Saxony, Wurtemberg and other States many of theirs; and the belief prevails that finally the private railroads will be purchased. So far as the absorption of the State railroads is concerned, it seems to be a stroke of policy to secure more firmly the unity of the Empire. The formation of little State railroad systems within the Empire and largely independent of the Imperial Government, is regarded as a danger, in case, in time of war, some of the States should be disaffected; which is a possibility that needs to be guarded against. If the private railroads are needed to complete great lines and systems, they would be taken for the same reason. But the discussion of the subject shows that there is in Germany a wide-spread feeling that in its circumstances the existing mixed system of both State and private railroads is economically the most advantageous, the reasons urged being often much like those employed by Mr. Charles Francis Adams, Jr., in his address before the Massachusetts Legislature, with reference to the utilization of the Hoosac Tunnel, and elsewhere. Mr. Adams usually cites Belgium as an example of the "mixed system." But the German States supply many others.

The Imperial Railroad Bureau of the German Empire reports concerning railroad accidents in the Empire (exclusive of Bavaria, which is not within the jurisdiction of the Bureau) in the year 1875, as follows: There were 755 derailments and collisions of time-table trains (225 express, fast and passenger trains, 36 mixed trains and 494 freight trains); 1,376 derailments and collisions in switching (260 obstructing operation and 1,116 not obstructing it); and 1,250 other accidents which occasioned some disturbance of the regular operation. One train out of every 5,394 passenger trains, and one out of every 2,290 freight trains met with some accident. To each collision or derailment 2,052,113 *axle-miles* of all kinds of trains were run, against 2,095,308 axle-miles in the second half of 1874; 517 cases were subjected to judicial investigation; in 209 (40.4 per cent.) no charge was made against any person; in 118 cases (22.8 per cent.) 46 persons were found not guilty, and 115 persons were condemned to imprisonment aggregating eight years and two days; finally, 190 cases are not yet concluded. Aside from the punishments mentioned above, disciplinary punishments were inflicted in 1,107 cases (32.8 per cent.)

The number of persons killed and injured on the railroads (aside from 120 killed and 14 injured in attempting suicide) were:

	Killed.	Injured.
Passengers	15	70
Employes	190	765
Road laborers	169	656
Other persons	135	94
Total	509	1,585

Of the injured, 114 died afterward, 139 were disabled a week or less, 440 more than one week and not more than four, 487 more than four weeks, 124 more than three months, 45 more than six months, 125 are still suffering, and in 112 cases the period of disability was unknown.

Of the 1,907 cases of accidents in operation in which death or injury occurred, 1,186 (62.2 per cent.) received judicial investigation; in 1,050 of these cases no indictment was found; in 24 cases (2 per cent.) after trial 9 persons were acquitted, and 18 persons were sentenced to 2 years, 10 months and 28 days' imprisonment; and besides disciplinary punishments were inflicted in 41 cases. There was one passenger killed to 11,402,067 carried, and one injured to 2,443,300 carried; on the other hand, one employe out of 648 was killed and one out of 161 injured! There was a person killed or injured in 1875 to every 2,088,373 *axle miles* run and to every 9.2 miles of road worked, against one to 1,779,640 axle-miles and 7.1 miles of road during the last half of 1874. This indicates a decrease in the relative frequency of injuries by railroad accidents at the rate of about 19 per cent.

An association of the Austrian and Hungarian railroads has determined to send abroad four engineers to make a study of the so-called "intercommunication signals" and other railroad apparatus. Two commissioners will travel in Germany, France and Belgium, and to them will be entrusted the preparation of a report on an exhibition of safety appliances for railroads to be held in Brussels from June to October of this year. The other delegates will travel in Switzerland and England, and they are to make a thorough study of continuous brakes, and especially of the Westinghouse and the Smith systems.

English railroad papers have an advertisement of the Madras (India) Railway Company for an Assistant Locomotive Superintendent, "commencing salary £600 per annum, with a free passage to Madras." All salaries are comparatively high in India.

The longest sleeping-car route in Great Britain was to be opened on the 1st of May by the Midland Company, which by the completion of the Settle & Carlisle Railway is enabled to open new routes from London to Edinburg and Glasgow. It announces that a morning express will be run with Pullman drawing-room cars, and a night express with Pullman sleeping cars.

On the London & Northwestern Railway for the year ending with June, 1874, the average receipt per passenger train mile, $1.22½ gold, and per freight train mile $1.55—equivalent to about $1.37⅛ and $1.74⅛ in American currency.

The American system of passenger cars mounted on swiveling trucks at each end seems to grow in favor in England since the introduction of the Pullman cars on the Midland Railway. Last January it was announced that the Great Western Railway would put on special fast trains between London and Plymouth, for which passenger carriages would be made "on eight wheels fixed to bogie platforms specially adapted to the sharp curves of the South Devon line." This line is of 7-feet gauge. Already the East Coast Railway company had made a trial trip with a train from York to Glasgow, composed of cars 60 feet long mounted on trucks. These cars have seven compartments each, wider than the ordinary English car, and with sleeping berths in the end compartments. Near the end of the last month we find that cars had just been completed for the Midland Railway of the same general type. They are 54 feet long and have each eight compartments—four third-class and three first-class (there is no second-class on the Midland), and one compartment for baggage. These are mounted on six-wheel trucks. "The most striking improvement," says an English paper, "is the clerestory roof, better known, perhaps, as the 'tunnel' roof, which gives an air of lightness and space as refreshing as novel to a railway passenger." The new cars are to run between London and Carlisle. Not a word is said as to their being copied from American examples, though Pullman cars are running on the same road. We warn our English

friends that while they can make their passenger traffic much more comfortable with such cars, they can easily make it very costly, too.

The Cumberland & Pennsylvania Railroad and the Cumberland Coal Trade.

The coal mining companies of the Cumberland Region appear at first sight to have unusual facilities for the transportation of the product of their mines to market. From Cumberland to tide-water there are three competing routes: The Chesapeake & Ohio Canal extending to the Potomac at Georgetown or Alexandria and connecting at Williamsport with the Western Maryland Railroad for Baltimore; the Baltimore & Ohio with its wharves on the harbor of Baltimore, and the Pennsylvania Railroad, ready to deliver coal on the harbors of Baltimore, Philadelphia and New York. None of the mines, however, are situated directly upon any of these three lines of transportation, and in order to reach them all coal is obliged to pass, for a greater or less distance, over the line until lately known as the Cumberland & Pennsylvania Railroad. This road, extending from Cumberland to Piedmont, 38 miles, with two branches, one 14 miles long built to reach certain mines, and another of three miles giving connection with a branch line of the Pennsylvania Railroad, were nominally owned by the Cumberland & Pennsylvania Railroad Company, but really by the Consolidation Coal Company, the leading mining company of the region. That company owned all the stock of the railroad company but a few shares used to qualify directors, and for all practical purposes the two corporations were one. That the business is important is shown by the statement that on this short line of railroad and its branches there were handled in 1875 2,188,436 tons of coal, of which 448,923 tons were mined by the Consolidation Company and the remaining 1,739,513 tons by the other companies, or, as they are frequent-called, the "outside" companies.

Naturally enough, the great control of the trade which the possession of the railroad gave to the Consolidation Company was anything but agreeable to those outside companies. There appeared to be no way of escaping from it but by the construction of a parallel and competing line, and, as such a line through a wild and difficult mountain country would be a very expensive one, they were unable to raise the necessary capital, or at any rate were reluctant to risk the large amount required. It resulted from these considerations that, while the outside companies continued to complain of the situation, nothing was done to change it until very recently.

Meantime, however, a new element appeared which had to be taken into account. The Cumberland coals for many years had almost a monopoly of their peculiar market, but within the past few years the semi-bituminous coal deposits of the Clearfield Region in Pennsylvania had been rapidly developed, and the coal product of that region had increased with extraordinary rapidity. The Clearfield coal producers are indeed dependent upon a single line of transportation, but that line, taking an enlightened view of its own interests, has done much to help the growth of the trade, and has given it such moderate rates that the Clearfield coals are enabled not only to compete with the Cumberland, but even to beat them in the market. Their quality, especially as a steam coal, is said to be fully equal to the Cumberland, and they can now be placed at tide-water at a lower price.

It became apparent to the Cumberland companies that something must be done to enable them to preserve their trade, and they accordingly resolved to apply to the Maryland Legislature for some relief from what they claimed to be excessive charges for transportation. The rates charged by the Cumberland & Pennsylvania Railroad were, for all distances over 10 miles, 3 cents per ton per mile; for distances between 5 and 10 miles, 4 cents; and for less than 5 miles, 5 cents per ton per mile. These rates did not include any terminal expenses of loading or unloading, being merely for the hauling of the cars. In the memorials and arguments presented to the Legislature the outside companies claimed that the rates were exorbitant; that the profits of the railroad were very great; that the Consolidation Company, being supported by those profits, refused to enter into any agreement to reduce the cost of mining or to join in any measure for the relief of the trade. They charged that its real purpose was to break down and impoverish the other companies, so that it could eventually acquire their property and absorb the whole trade. On the other hand the Consolidation Company represented that its rates were not too high, considering the steep grades and difficult character of the road, and that the return on the money invested in it had been hitherto very small, indeed entirely inadequate. The Legislature, however, listened to the petitioners and passed a law fixing the maximum rates allowed to be charged for transportation at 2, 3 and 4 cents per ton per mile, being one cent per ton per mile less than the old rates in each case.

It was generally expected that the Consolidation Company would contest the law, but its next move was a somewhat unexpected one. It was found that by a deed executed March 2, before the passage of the law, though not recorded until some weeks later, the Cumberland & Pennsylvania Railroad Company had sold and transferred its road to the Consolidation Coal Company, which thus became the legal as well as the actual owner of the road. Its charter gave it power to own and work railroads as well as to mine coal, and also gave it almost unlimited power as to rates. Under these powers it now works the road and continues to charge the old rates. It has renamed the road the Cumberland & Piedmont Railroad, and claims that the law reducing rates cannot apply in its case.

Though somewhat confused by these unexpected movements the outside companies have not by any means given up the fight. The Legislature of Maryland meets only every second year, and no relief could be obtained from it until 1878, unless the Governor should call an extra session, which is not probable, and even then the relief would be doubtful. Upon their motion, however, the Attorney-General of the State has begun suit to test the validity of the transfer of the railroad and also the right to continue to charge the old rates. Another question is raised, which, however, does not seem likely to be pressed. The charter of the Consolidation Company was passed near the close of the session of 1860, in the midst of an exciting political debate, and it is alleged that in reality it never passed the House of Delegates, that the certificate to that effect is a forgery, and that the company has therefore no legal existence. This, however, appears to be somewhat doubtful.

Meantime the situation of the Cumberland companies is not a very desirable one. With active and aggressive rivals for their trade, they are hampered with what they claim to be excessive transportation rates; no combination to reduce the cost of production is now possible, and relief can be hoped for only at the end of a long litigation. Whatever opinion may be entertained as to the wisdom of the Consolidation Company's policy, it is evidently master of the situation at present, and likely to remain so for some time, unless the courts shall decide that the act of the Legislature reducing rates was, in the first place, valid as to the Cumberland & Pennsylvania Railroad Company, and, in the second place, that its provisions bind any successor of that company, which, as no public notice had been given as to the change of proprietor, is quite probable; though the introduction of this question may well delay the final decision.

Pacific Railroad Sinking Funds.

A new Pacific Railroad act has been reported by the Committee on the Judiciary of the lower house of Congress, which aims to provide for the accumulation of a sinking fund from the various Pacific railroads, with which to extinguish at maturity the debts to the Government which will accrue near the year 1900. The act requires that the Union Pacific, "on its own account and for its several branches" (it has no branches), shall pay $375,000 half-yearly into such a sinking fund for ten years, beginning next July, and $500,000 every half-year thereafter *in addition to* half the earnings from Government business on the road and the 5 per cent. of net earnings required by the old law. The Central Pacific is to be required to pay $568,210 a year for ten years and $760,330 afterwards, the intention having been, probably, to have each company pay in proportion to the amount of the Government bonds it received. In the case of the Union Pacific the amount required is at the rate of $727 per mile for the first ten years, and $970 per mile thereafter, equivalent to 2 per cent. on the stock at first and 2⅔ per cent. thereafter. This by itself would not be a very serious matter to a company which pays 8 per cent. dividends, but must perhaps give them up for ever after the lapse of 21 years if it does not provide some way of paying the great debt then maturing. But as we have said, the proposed law requires that this payment be made in addition to 5 per cent. of the net earnings, which by the government interpretation will amount to as much more, at least. No intimation is made as to the interest to be allowed on the half-yearly payments, further than that the Secretary of the Treasury is directed "to invest and reinvest to the best advantage" money collected under the act.

It is perhaps presumptuous to question the validity of a law reported by a Judiciary Committee of the United States Congress—a body that might be supposed to know the law, if nothing else; but how the provisions of this act, which provides for the enforcement of it by suits at law and prohibit dividends if the proposed sinking funds are not made, can be reconciled with the recent decision of the Supreme Court, we are unable to see. By that decision it was expressly declared that neither interest nor principal of the bonds loaned by the Government become due until the maturity of the bonds about 1897. To compel the companies to establish a sinking fund is substantially collecting payment twenty years before the debt is due. It may be done with their consent, but hardly without it. The Government has no claim against the companies now (unless the pending case in the Supreme Court shall so decide), and one can hardly call upon the law to compel his debtor to lay aside money every year to meet a payment due twenty years hence, simply because he fears that said debtor may not be able to pay when he has promised to. In this case, too, the Government has security, expressly agreed upon and accepted by it. We do not see how the original contract between the Government and the companies can be changed now by the former without the consent of the latter. The Government can and does withhold half of the dues for transportation on its traffic, and can collect yearly 5 per cent. of the companies' net earnings; but this is all the original contract provided for, and if a new one is made, both parties must consent to it to make it valid.

A Race Across the Continent.

A New York firm, well known as theatre managers, Messrs. Jarrett & Palmer, have undertaken to attempt the extraordinary feat of running a train across the entire continent, from New York to San Francisco, within four days. The newspapers have generally stated the time as 84 hours, and as reduced to a fixed schedule; but the circular of the firm in which they solicit passengers only gives the starting time as 1 a. m., Thursday, June 1, and says that "it is confidently anticipated that the guests on this trip will dine in San Francisco on the following Sunday," which, if the "guests" will consent to dine after 11 o'clock, will give the train 97 hours for the trip (3¼ hours gained by the difference of time), which, by the route selected, is 3,319 miles long, so that the average speed required is but 34.22 miles per hour, including stops, which are to be as few as possible. The train, besides engine and tender, will consist of one combination mail and baggage car, and one Pullman hotel car. The route will be by the Pennsylvania and Pittsburgh, Fort Wayne & Chicago roads from New York to Chicago (913 miles), the Chicago & Northwestern to Council Bluffs (490 miles), and thence, of course, by the Union Pacific and Central Pacific (1,916 miles). If the time to Chicago is no shorter than that of the fast mail, there will remain 71 hours in which to make 2,406 miles, necessitating a speed of 33.9 miles per hour. But the circular says the train will reach Chicago the "evening" of the same day it leaves New York, and putting the most liberal construction on the word "evening," would make the time for this part of the journey less than 24 hours, and reduce to 33 miles an hour the average speed requisite for the rest of the journey. It has been reported that the run from New York to Pittsburgh, 444 miles, will be made in 10 hours, *and without any stop*. If this is done it will be the most wonderful part of the trip, for the route is for much of the way over mountains and on one of the most crowded roads in the world. It ought to be possible to make the rest of the distance to Chicago, which is over a comparatively straight and level road, in less time, for the distance is but 25 miles greater.

The Chicago & Northwestern has several times, with special trains, made much greater speed than this train will require, and the Pacific roads, which usually are in excellent condition and not at all crowded, ought to be capable of 40 miles an hour, though their ordinary passenger trains run only about half as fast, because the slower speed is more economical.

Even if the train makes the trip in 84 hours apparent time (which would be 87¼ hours actual time), the average speed would be but 38 miles an hour. The difficulty will be in keeping it up over so long a route with the same cars. Some extraordinary stories have been told as to the runs to be made without stopping. According to these an engine will run through from Omaha to Ogden, 1,033 miles! How its coal and water are to be provided was not explained.

The running of this train seems to be a sort of speculation on the part of Jarrett & Palmer, who offer the following "inducements" for the purchase of a ticket:

"Tickets for the trip are elegantly bound in covers of solid sterling silver, of unique workmanship and superb finish. These are limited to sixteen (several of which have already been engaged), and each entitles the holder:

"1. To passage to San Francisco on the special fast train.
"2. To one double berth on Pullman palace car.
"3. Meals *en route* on the palace hotel car, *a la carte*.
"4. One week's board at the Grand Palace Hotel, San Francisco.
"5. First-class return ticket from San Francisco to New York, good until used."

All of which reads for all the world as if the enterprise were conducted by the late lamented James Fisk, Jr. The price of a ticket is $500.

It is quite probable that when the Pacific coast has a population something like as dense as that on this side of the continent, there will be a regular daily train making as good time as this, without counting at all upon improved appliances. Many English routes (of course very much shorter than this) have faster trains; and just as soon as it is shown that they will pay, we shall have them here.

Record of New Railroad Construction.

This number of the *Railroad Gazette* has information of the laying of track on new railroads as follows:

Scioto Valley.—Extended from Circleville, O., south to Kingston, 10 miles.

Columbus & Toledo.—The first track is laid from Delaware, O., north 6 miles.

Wisconsin Central.—Track on the *Portage Extension* has been extended from Plainfield, Wis., south 10 miles.

St. Louis, Keokuk & Northwestern.—*The Louisiana Extension* is completed by laying 6⅛ miles of track between Louisiana, Mo., and Hannibal.

This is a total of 32⅛ miles of new railroad, making 518 miles completed in the United States in 1876, against 250 miles reported for the same period in 1875, 429 in 1874, and 827 in 1873.

Technical Conventions.

The Master Car-Builders' Association will hold its annual meeting in New York, Wednesday, June 14.

The annual convention of the American Society of Civil Engineers will be held in Philadelphia, June 13.

Correction.

In our report of the proceedings of the Master Mechanics' Association published last week, Mr. Hudson was reported to have said "that nearly all the water evaporated by the tubes of a locomotive occurs in the first few inches of the first foot of their length." This should have been "in the first few inches *or* the first foot of their length."

THE PAN-HANDLE RAILROAD, as it is commonly known—that is the part of the Pittsburgh, Cincinnati & St. Louis from Pittsburgh to Columbus with an 8-mile branch to Cadiz—really one of the great trunk lines of the country, being the main artery of a system of lines over which a chief part of the circulation between Ohio River cities and a belt of country thence north a hundred and fifty miles moves to and from the East, earned gross in 1875 $15,833 per mile against $17,812 in 1874; its net earnings were $3,659 in 1875 and $4,969 in 1874. The interest charge on funded debt in 1875 was about equal to the net earnings, not counting the interest on the second-mortgage bonds, which, by an arrangement with the holders, is due only when the net earnings are sufficient to meet it. The decrease in earnings is entirely due to reductions in rates, there having been a small increase in both passenger and freight traffic and a decrease of 5 per cent in expenses. With more than a hundred thousand dollars of interest on the floating debt, the company netted a loss of $131,700, during the year, which is $20,000 less than the profit of the previous year.

The lines leased by this company have comparatively meagre earnings. The Little Miami, probably the chief Eastern outlet of Cincinnati, brought in but $6,344 per mile in 1875; the Columbus, Chicago & Indiana Central, one of whose lines is part of a lead-

RAILROAD EARNINGS IN APRIL.

Name of Road.	Mileage.					Earnings.					Earnings per Mile.	
	1876.	1875.	Inc.	Dec.	Per c.	1876.	1875.	Increase.	Decrease.	Per c.	1876.	1875.
Atchison, Topeka & Santa Fe	711	507	204	.....	40.2	$198,955	$111,152	$87,803	.....	79.0	$280	$219
Cairo & St. Louis	146	146	.....	.....	.....	16,884	24,981	.....	$8,117	32.5	116	171
Canada Southern	452	452	.....	.....	.....	168,452	106,755	61,697	.....	57.8	373	236
Central Pacific	1,315	1,293	22	.....	1.7	1,468,000	1,366,984	101,016	.....	7.4	1,116	1,057
Chicago & Alton	650	650	.....	.....	.....	353,530	367,955	.....	14,425	3.9	544	566
Chicago, Milwaukee & St. Paul	1,400	1,399	1	.....	.....	650,944	639,669	11,275	.....	1.8	465	457
Cincinnati, Lafayette & Chicago	75	75	.....	.....	.....	31,409	32,865	.....	1,456	4.4	419	438
Denver & Rio Grande	120	120	.....	.....	.....	31,846	32,162	.....	316	1.0	265	268
Illinois Central	1,109	1,109	.....	.....	.....	546,081	610,459	.....	64,378	10.5	492	550
Indianapolis, Bloomington & Western	344	344	.....	.....	.....	130,308	102,876	27,432	.....	26.7	379	299
International & Great Northern	459	459	.....	.....	.....	77,769	86,455	.....	8,686	10.0	169	188
Kansas Pacific	784	761	23	.....	3.0	241,718	293,347	.....	51,629	17.6	308	385
Michigan Central	804	804	.....	.....	.....	610,543	600,066	10,477	.....	1.7	759	746
Missouri, Kansas & Texas	786	786	.....	.....	.....	214,788	192,471	22,317	.....	11.6	273	245
Nashville, Chattanooga & St. Louis	342	344	.....	.....	.....	133,464	129,430	4,034	.....	3.1	390	378
Ohio & Mississippi	615	615	.....	.....	.....	306,637	273,441	33,196	.....	12.1	499	445
Pacific, of Missouri	426	426	.....	.....	.....	283,732	253,779	29,953	.....	11.8	666	596
St. Louis, Alton & Terre Haute—Belleville Line	71	71	.....	.....	.....	37,701	40,446	.....	2,745	6.8	531	570
St. Louis, Iron Mountain & Southern	685	685	.....	.....	.....	283,547	275,352	8,195	.....	3.0	414	402
St. Louis, Kansas City & Northern	504	504	.....	.....	.....	234,002	220,692	13,310	.....	6.0	464	438
St. Louis & Southeastern	349	349	.....	.....	.....	79,266	85,935	.....	6,669	7.8	227	246
St. Paul & Sioux City	122	122	.....	.....	.....	36,006	36,417	.....	411	1.2	295	299
Sioux City & St. Paul	148	148	.....	.....	.....	21,840	22,449	.....	609	2.8	148	152
Toledo, Peoria & Warsaw	237	237	.....	.....	.....	118,043	74,809	43,234	.....	57.8	498	311
Totals	12,654	12,404	250	.....	.....	$6,275,445	$5,980,947	$453,939	$159,441	.....	$496	$482
Total increase	.....	.....	250	.....	2.0	.....	.....	294,498	.....	4.9	.....	.....

RAILROAD EARNINGS, FOUR MONTHS ENDING APRIL 30.

Name of Road.	Mileage.					Earnings.					Earnings per mile.				
	1876.	1875.	In.	Dec	Per c.	1876.	1875.	Increase.	Decrease	P.c.	1876.	1875.	Inc.	Dec.	P.c.
Atchison, Topeka & Santa Fe	660	507	153	....	30.2	$640,751	$362,272	$278,479	.....	43.5	$971	$715	$256	.....	35.8
Cairo & St. Louis	146	124	22	....	17.7	76,874	70,763	6,111	.....	8.6	527	571	.....	$44	7.7
Canada Southern	452	452	....	....	.....	598,785	318,804	279,981	.....	87.8	1,325	705	620	.....	87.8
Central Pacific	1,315	1,293	22	....	1.7	4,562,000	4,373,344	188,656	....	4.3	3,469	3,382	85	.....	2.5
Chicago & Alton	650	650	....	....	.....	1,361,505	1,379,729	.....	$18,224	1.3	2,095	2,123	.....	28	1.3
Chicago, Milwaukee & St. Paul	1,400	1,399	1	....	.....	2,263,332	1,931,808	331,524	.....	17.2	1,617	1,381	236	.....	17.1
Cincinnati, Lafayette & Chicago	75	75	....	....	.....	130,332	124,339	5,999	.....	4.8	1,738	1,658	80	.....	4.8
Denver & Rio Grande	120	120	....	....	.....	127,339	102,686	24,653	.....	24 0	1,062	856	206	.....	24.0
Illinois Central	1,109	1,109	....	....	.....	2,348,148	2,278,690	69,458	.....	3.0	2,117	2,055	62	.....	3 0
Indianapolis, Bloom. & West'n	344	344	....	....	.....	569,856	425,555	84,301	.....	19.8	1,482	1,237	245	.....	19.8
International & Gt. Northern	459	459	....	....	.....	431,832	433,127	.....	1,295	0.3	941	944	.....	3	0.3
Kansas Pacific	767	761	6	....	0.8	875,363	920,679	.....	45,316	4.9	1,141	1,210	.....	69	5.7
Michigan Central	804	804	....	....	.....	2,260,915	2,153,802	107,113	.....	5.0	2,812	2,681	131	.....	5.0
Missouri, Kansas & Texas	786	786	....	....	.....	971,784	820,480	151,304	....	18.3	1,236	1,044	192	.....	18.3
Nashville, Chattanooga & St. L.	342	342	....	....	.....	614,652	554,739	59,913	.....	10 8	1,797	1,622	175	.....	10.8
Ohio & Mississippi	615	504	111	....	22.0	1,229,853	1,074,321	155,532	.....	14.5	2,000	2,132	.....	132	6.2
Pacific, of Missouri	426	426	....	....	.....	1,183,956	951,388	232,568	.....	24.4	2,779	2,233	546	....	24.4
St. Louis, Alton & Terre Haute, Belleville Line	71	71	....	....	.....	157,974	202,732	.....	44,758	22.1	2,225	2,855	.....	630	22.1
St. Louis, Iron Mt. & Southern	685	685	....	....	.....	1,219,057	1,083,963	135,094	.....	12.5	1,780	1,582	198	.....	12.5
St. Louis, Kansas City & North'n	504	504	....	....	.....	1,034,210	868,926	165,284	.....	19.0	2,052	1,724	328	.....	19.0
St. Louis & Southeastern	349	349	....	....	.....	329,087	340,458	.....	11,371	3.3	943	978	.....	35	3.3
St. Paul & Sioux City	122	122	....	....	.....	161,748	107,233	54,515	.....	50.8	1,326	879	447	.....	50.8
Sioux City & St. Paul	148	148	....	....	.....	102,671	56,128	46,543	.....	83 0	694	379	315	.....	83.0
Toledo, Peoria & Warsaw	237	237	....	....	.....	432,228	280,860	151,368	.....	53.9	1,823	1,185	638	.....	53.9
Totals	12,586	12,271	315	....	.....	23,624,258	21,216,826	$2,528,39.	$120,964	.....	$1,877	$1,729	$148	.....	8.6
Total increase	.....	.....	315	....	2.6	.....	.....	2,407,432	.....	11.3	.....	.....	.....	.....	.....

ing route between the East and Indianapolis, Louisville and St. Louis, and part of a route to Chicago, earned per mile $6,235 gross and but $1,045 net.

THE PITTSBURGH, FORT WAYNE & CHICAGO RAILWAY, whose brief report for 1875 we republish, maintains its position as the only one of the lines forming the western half of a route between Chicago and the East which makes good profits. Though for the year in question gross and net earnings were less than the year before by 8⅓ and 8 per cent. respectively, still the gross earnings were $16,789 per mile and the net earnings $6,963, and the lessee, after paying the rental charges, including interest on the funded debt and 7 per cent. dividends on the stock, had left a profit of more than a thousand dollars a mile. The report gives no statistics of the traffic of the year or of the average receipts and expenses per unit of traffic, which would be extremely interesting in view of the railroad war of last year, in which this road had to bear a prominent part.

APRIL EARNINGS are reported in our table for 24 railroads with about one-sixth of the total mileage of the United States. The results cannot be called favorable, as they show but a small increase over the unfavorable returns of last year. This increase is nearly 5 per cent. in the total, but less than 3 per cent. in receipts per mile of road, which were $482 last year and $496 this.

For the four months ending with April the returns have a better look, due of course to the much better business of the winter months. The same 24 roads report for this period and show an increase of 8⅓ per cent. in earnings per mile, which have grown from $1,729 to $1,877. Only one of the trunk lines involved in the present railroad war reports earnings, and that (the Michigan Central) reports a slight increase over the receipts for April of last year—when also it was involved in a railroad war which gave it a large business at very low rates.

THE ERIE RAILWAY, by the laying of the third rail between Waverly and Buffalo, which was completed on the 22d, becomes part of a tolerably short and extremely picturesque through route from the West to Philadelphia, and will be able to compete for Philadelphia business, which it could never do before. It is intended to run passenger trains through from Buffalo to Philadelphia during the World's Fair at least, for which a considerable traffic may reasonably be expected.

General Railroad News.

PERSONAL.

—A patriarch among trackmen was Peter Fox, who over forty years ago, when little more than a boy, obtained work in a gang employed in laying the track of the New Jersey Railroad between Rahway and New Brunswick, and from that time to his death patiently and faithfully performed his daily share of the labor of keeping that track in order. As he had lived by the railroad, so he died by the railroad, and one evening last week, as he was walking along the track near Rahway, he was struck by the engine of the limited express and killed.

—Mr. Henry Raworth, of Aiken, S. C., is in all probability the oldest locomotive engineer in the United States, if not in the world. His first trip was made on the South Carolina Railroad out of Charleston, in 1831, and he has been on the same road ever since, a period of 45 years, with the exception of ten months, when he was employed in running a small Government steamer in Florida during the Seminole war. We doubt whether any other engineer can show so long a term of service. Mr. Raworth's present fireman, Adam Perry, a colored man, has been with him 19 years, and has been in the service of the company 37 years.

—It is reported that Mr. M. W. Serat, formerly of the Erie and later of the New Jersey Southern, will shortly be made General Superintendent of the Utica, Ithaca & Elmira.

—Mr. L. S. Canfield, formerly Superintendent of the South Side Railroad of Long Island, is now one of the contracting firm of Tappan & Canfield, which is building the Manchester & Keene Railroad. He has also a large contract for a railroad in Colombia, South America.

—Mr. J. Donald Cameron, for several years and up to 1874 President of the Northern Central Company, has been appointed Secretary of War. He is largely interested in railroad and manufacturing property, chiefly in Pennsylvania. Hon. Alphonso Taft, whom he succeeds, and who is now Attorney-General, was for several years and until recently, a trustee of the Cincinnati Southern.

—Mr. J. H. Hager, Paymaster of the Terre Haute & Indianapolis road, died of paralysis May 16.

—Hon. Wm. Dewey, one of the original projectors and constructors of the Rome, Watertown & Ogdensburg road, died recently at his residence in Three Mile Bay, N. Y.

—Mr. Samuel Thome has resigned his position as Superintendent of Iron Ore Mines for the Philadelphia & Reading Coal & Iron Company, to accept an appointment in the Topographical Engineer Corps of the Argentine Confederation of South America. Mr. Thome sailed for Buenos Ayres last week.

TRAFFIC AND EARNINGS.

Passenger Rates to the Centennial.

A meeting of the General Passenger Agents of the trunk lines was held in Philadelphia, May 18. The object was to arrange for the opening of a joint ticket office on the Exposition grounds, but it is stated that there was some discussion of the question of lower rates. It seeming to be the unanimous opinion that no further reduction in the general passenger rates was advisable, Mr. Boyd, of the Pennsylvania, made the suggestion that special excursion trains be run once a week from principal points in the East, West and South, to start Saturday nights and reach Philadelphia by Sunday night or Monday morning, returning on a similar time table. The purpose of these trains, Mr. Boyd said, would of course be to give the poorer classes a chance to visit the Exhibition, and as the trains would be run at a comparatively low rate of speed the fare could probably be put at a very low figure. Mr. Boyd's suggestion was considered at some length, but the consultation terminated without any definite understanding having been reached, and the matter will be taken up again at another meeting to be held in Philadelphia this week.

Railroad Earnings.

Earnings for various periods are reported as follows:

Year ending Dec. 31:

	1875.	1874.	Inc or Dec.		P. c.
Charters	$72,029	$71,156	Inc ..	$873	1.2
Expenses	37,301	52,505	Dec..	15,204	29.0
Net earnings	$34,728	$18,651	Inc ..	$16,077	86.2
Earnings per mile	3,160	3,121	Inc ..	39	1.2
Per cent. of expenses.	51.8	73.8	Dec..	22 0	29.8
Cin. & Muskingum Val.	396,227	429,829	Dec..	33,602	7.8
Expenses	360,483	433,429	Dec..	72,946	16.8
Net earn. or deficit	$35,744	$3,600	.....	.....	....
Earnings per mile	2,670	2,900	Dec..	$230	7.8
Per cent. of expenses.	90.9	100.8	Dec..	9.9	9.8
Col., Chic. & Ind. Cent.	3,619,654	3,863,833	Dec..	244,179	6.3
Expenses	3,013,212	2,929,842	Inc ..	83,370	2.8
Net earnings	$606,442	$933,991	Dec..	$327,549	35.1
Earnings per mile	6,235	6,656	Dec..	421	6.3
Per cent. of expenses.	83.25	75.83	Inc ..	7.42	9.8
Little Miami	1,242,787	1,338,612	Dec..	95,825	7.2
Expenses	998,915	1,072,187	Dec..	73,272	6.8
Net earnings	$243,872	$266,425	Dec..	$22,553	8.5
Earnings per mile	6,344	6,833	Dec..	489	7.2
Per cent. of expenses.	80.4	80.1	Inc ..	0.3	....
Kan. City, St. Joe & Council Bluffs	1,362,706	1,436,073	Dec..	73,367	5.1
Expenses	1,010,836	941,165	Inc ..	69,671	7.4
Net earnings	$351,870	$494,908	Dec..	$143,038	28.9
Earnings per mile	4,964	5,232	Dec..	268	5.1
Per cent. of expenses.	74.18	65.54	Inc ..	8.64	13.2
Pittsburgh, Ft. Wayne & Chicago	7,863,664	8,599,472	Dec..	735,808	8.6
Expenses	4,602,092	5,055,330	Dec..	453,238	9.0
Net earnings	$3,261,572	$3,544,142	Dec..	$282,570	8.0
Earnings per mile	16,789	18,375	Dec..	1,586	8.6
Per cent. of expenses.	58.52	58.79	Dec..	0.27	....
Pitts., Cin. & St. Louis.	3,175,970	3,573,316	Dec..	397,346	11.1
Expenses	2,442,008	2,576,534	Dec..	134,526	5.2
Net earnings	$733,962	$996,782	Dec..	$262,820	26.4
Earnings per mile	15,833	17,812	Dec..	1,979	11.1
Per cent. of expenses.	76.8	72.1	Inc ..	4.7	6.5
Rome, Watertown & Og.	1,167,924	1,173,001	Dec..	5,077	0.4
Expenses	885,585	770,257	Inc ..	115,328	15.0
Net earnings	$282,239	$402,644	Dec..	$120,405	29.9
Per cent. of expenses.	75.83	65.67	Inc ..	10.16	15.5
St. Louis, Vandalia & Terre Haute	1,031,414	1,065,433	Dec..	34,019	3.2
Expenses	829,395	802,842	Inc ..	26,553	3.3
Net earnings	$202,019	$262,591	Dec..	$60,572	23.1
Earnings per mile	6,512	6,726	Dec..	214	3.2
Per cent. of expenses.	80.50	75.35	Inc ..	5.15	6.8

Year ending March 31:

	1875-76.	1874-75.			
Cin., Hamilton & Dayton	$1,147,753	$1,128,355	Inc ..	$19,398	1.7
Expenses	677,577	662,458	Inc ..	15,119	2.3
Net earnings	$470,176	$465,897	Inc ..	$4,279	0.9
Earnings per mile	19,129	18,806	Inc ..	323	1.7
Per cent. of expenses.	59.03	58.71	Inc ..	0.32	0.1
Cin., Hamilton & Ind.	427,524	398,752	Inc ..	28,772	7.2
Expenses	413,844	370,472	Inc ..	43,372	11.7
Net earnings	$13,680	$28,280	Dec..	$14,600	51.6
Earnings per mile	4,362	4,069	Inc ..	293	7.2
Per cent. of expenses.	96.80	92.91	Inc ..	3.89	4.2
Cin., Richmond & Chic.	221,117	234,100	Dec..	12,983	5.5
Expenses	164,605	149,005	Inc ..	15,600	10.5
Net earnings	$56,512	$85,095	Dec..	$28,583	33.6
Earnings per mile	4,914	5,202	Dec..	288	5.5
Per cent. of expenses.	74.44	63.59	Inc ..	10.75	16.9
Dayton & Michigan	1,079,385	1,056,909	Inc ..	22,476	2.1
Expenses	649,916	703,891	Dec..	53,975	7.7
Net earnings	$429,469	$353,018	Inc ..	$76,451	21.7
Earnings per mile	7,501	7,443	Inc ..	158	2.1
Per cent. of expenses.	60.21	66.60	Dec..	6.39	9.6
Texas & Pacific	1,518,491	.....	.....	.....	....
Expenses	854,918	.....	.....	.....	....
Net earnings	$663,573	.....	.....	.....	....
Earnings per mile	4,687	.....	.....	.....	....
Per cent. of expenses.	56.30	.....	.....	.....	....
Concord	950,358	$1,002,950	Dec..	$52,592	5.2
Expenses	675,060	692,046	Dec..	16,986	2.5
Net earnings	$275,298	$310,904	Dec..	$35,606	11.5
Earnings per mile	8,448	8,915	Dec..	467	5.2
Per cent. of expenses.	71.03	69.00	Inc ..	2.03	2.9

Four months ending April 30:

	1876.	1875.			
Nashville, Chattanooga & St. Louis	$614,650	$554,738	Inc ..	$59,912	10.8
Expenses	373,552	394,266	Dec..	20,714	5.3
Net earnings	$241,098	$160,472	Inc ..	$80,626	50.2
Per cent. of expenses.	60.77	71.08	Dec..	10.31	14.5
Philadelphia & Erie	1,005,961	909,096	Inc ..	96,865	10.7
Expenses	699,230	639,788	Inc ..	59,442	9.3
Net earnings	$306,731	$269,308	Inc ..	$37,423	13.9
Per cent. of expenses.	69.51	70.37	Dec..	0 86	1.2
St. Paul & Sioux City	161,748	107,233	Inc ..	54,515	50.8
Expenses	113,738	.....	.....	.....	....
Net earnings	$48,010	.....	.....	.....	....
Per cent. of expenses.	70.34	.....	.....	.....	....
Sioux City & St. Paul	102,671	$56,128	Inc ..	$46,543	83.0
Expenses	82,729	.....	.....	.....	....
Net earnings	$19,942	.....	.....	.....	....
Per cent. of expenses.	80.53	.....	.....	.....	....
First Week in May:					
Denver & Rio Grande	$8,184	$8,722	Dec..	$538	6.2
Second week in May:					
Missouri, Kan. & Texas	$44,797	$49,109	Dec..	$4,312	8.8
Ohio & Mississippi	75,046	61,965	Inc ..	13,081	21.1
St. Louis, Iron Mountain & Southern	70,600	58,346	Inc ..	12,254	21.0
St. Louis, Kansas City & Northern	57,345	51,878	Inc ..	5,467	10.5
Denver & Rio Grande	8,969	7,628	Inc ..	1,341	17.6
Week ending May 5:					
Great West'n, of Canada	£17,651	£17,030	Inc ..	£621	3.5
Week ending May 6:					
Grand Trunk	£35,800	£34,500	Inc ..	£1,300	3.8
Third Week in May:					
Chicago, Milwaukee & St. Paul	$187,000	$167,851	Inc ..	$19,119	11.5

The Michigan Central reports its net earnings for April as $212,542.54. The expenses for the month were 65.19 per cent. of the earnings.

Lake and Canal Freights.

Charters for wheat from Chicago to Buffalo were reported Tuesday of last week at 2¼ cents per bushel. At that time there were in store in Chicago less than 2,800,000, against

4,000,000 a week previous, and 8,500,000 a year ago. Evidently cargoes will not be had, however much rates are reduced, if the active movement of the first half of May continues a few weeks longer: there will be no grain left to ship.

Throughout the following week the prevailing rate on wheat from Chicago to Buffalo was 2⅛ cents per bushel, until Tuesday of this week, when charters at 2¼ cents were reported. Canal rates on wheat from Buffalo to New York were about 6¼ to 6¾ cents until Monday, when the rate was 6¼ for wheat, 5⅝ to 5¾ for corn, and 4 cents for oats—the lowest ever known—and these rates were continued Tuesday. Monday, also, the elevator rates at Buffalo were reduced from 1 cent to ⅞ cent, including five days' storage. Coal is taken from Buffalo to Chicago at 35 cents per ton, and charters at 25 cents are reported.

Ocean Freights.

Engagements of grain were reported in New York last Tuesday as follows: By steam to Hull, 8¼d. per 60 lbs.; by sail to Bristol, 7¼d.; by sail to Cork for orders, 8½d.; by steam to Havre or Antwerp, 9¾d. Refined petroleum by sail to Dantzic or Koenigsberg, 4s. 3d. per barrel; to Bremen, 3s. 1¼d. Cheese by steam to Liverpool, 50s. per ton. From Baltimore there were charters for grain by sail to Cork for orders at 8½d., 8⅝d. and 9d. From Philadelphia grain to Cork for orders at 8¾d., for the Penarth Roads for orders at 8¼d., and for the Continent 10d. per bushel. Petroleum from Philadelphia was taken for Antwerp at 3s. 6d. per barrel; for Bremen at 3s. 7½d. A charter of an American ship to carry grain from San Francisco to Liverpool is reported at 18⅝d. per bushel, which is about 10 cents a bushel more than the current rate from Chicago to Liverpool.

Grain Movement.

For the week ending May 13 the receipts and shipments, in bushels, of all kinds of grain at Northwestern ports were:

	1876.	1875.	Inc. or Dec.	P. c.
Receipts	2,302,046	2,536,560	Dec.. 234,514	9 2
Shipments	3,841,466	3,478,338	Inc.. 363,128	10.4

The receipts were less in 1876 than during the previous week by 25 per cent., the shipments less by 19 per cent.

For the week ending May 20 Chicago receipts and shipments were:

	1876.	1875.	Increase.	P. c.
Receipts	1,213,939	1,095,139	118,800	10.8
Shipments	1,887,359	1,038,198	849,161	81.8

Thus the stock was reduced by 673,000 bushels during the week, leaving abou t 2,115,000 bushels.

Compared with the previous week the Chicago movement was:

	Week ending May 13.	May 20.
Receipts	989,758	1,213,939
Shipments	2,281,214	1,887,359

This shows an increase of 22¼ per cent. in receipts and a decrease of 17⅓ per cent. in shipments.

East-bound Rates.

There seems to have been no change in rates since last week. Chicago papers report that contracts were generally made at 20 cents per hundred in grain to New York, 18 to Philadelphia, 17½ to Baltimore, and 22½ to 25 to Boston. There are no present signs of a change, but there usually are none until it is made. Traffic has been very heavy, but the material for it seems to be becoming exhausted.

Coal Movement.

Coal tonnages for the week ending May 13 are reported as follows:

	1876.	1875.	Inc. or Dec.	P. c.
Anthracite	321,208	279,629	Inc .. 41,579	14.9
Clearfield	27,117	8,532	Inc .. 18,585	217.8
Broad Top	3,393	.....	.....	....
Cumberland	44,497	61,603	Dec.. 17,106	27.8
Bituminous, Barclay	4,326	.....	.....	....

The coal tonnage of the Pennsylvania Railroad for the four months ending April 30 was as follows:

	Tons.
Anthracite	191,574
Semi-bituminous, Broad Top and Clearfield	426,694
" Cumberland	40,214
Bituminous, Gallitzin and Mountain Region	70,227
" Westmoreland and Pittsburgh regions	382,895
" West Pennsylvania Division	71,192
Total coal	1,152,796
Coke	251,287
Total	1,404,083

Being 127,644 car-loads of 11 tons each, or about 4,255 trains of 30 cars each.

OLD AND NEW ROADS.

Atlantic, Mississippi & Ohio.

Mr. Collinson, Agent for the English bondholders, has issued a circular explaining the causes which induced them to commence proceedings against the company. He charges in effect that it failed to carry out the terms of its agreement with them. The circular says, in conclusion:

"The consolidated bondholders have, therefore, through their trustees, made application, in the Circuit Court of the United States, for the appointment of a receiver to administer the affairs of the company.

"In taking this step it is the wish of the consolidated bondholders to give to you the strongest assurance that their policy is entirely opposed to any disintegration of the consolidated road; and that they intend to respect all equitable rights, other than their own, in the property."

Rome, Watertown & Ogdensburg.

Regular passenger trains on the Lake Ontario Division began running through to Lewiston last week.

Louisville, New Albany & St. Louis.

The foreclosure sale of this road has been postponed to June 20, at New Albany, Ind.

Cincinnati & Terre Haute.

The town of Worthington, Ind., has voted to subscribe $16,000 in aid of the extension of this road from Middlebury, Ind., to Worthington.

Boston, Clinton & Fitchburg.

It is stated that the agreement of consolidation between this company and the New Bedford Railroad Company has been finally settled. The stock of the New Bedford Company is to be put into the consolidation at $110; the Boston, Clinton & Fitchburg preferred at $75 and the common at $35. Holders of the Fitchburg Company's common stock will have the option of paying $65 and receiving one share of new for one of old stock, or of taking seven shares of new for each 20 of old stock. Holders of preferred stock may pay $25 per share and exchange share for share, or take three shares of new for four of old, while holders of New Bedford stock will receive 11 shares new stock for 10 of old, or one share new and $10 cash for one of old stock, or, if they so elect, may transfer their stock to the new company at $110 per share in money. The Fitchburg Company's stock consists of $1,063,000 preferred and $109,600 common; the New Bedford Company's capital stock is $1,678,500. A consolidated mortgage is to be executed to include the present bonded debt of both companies, which amounts to $1,721,100.

The consolidated company will own 121 miles of road and lease 26 more. Its proposed name is the Boston, Clinton, Fitchburg & New Bedford Railroad Company. The New Bedford road is now leased by the Boston, Clinton & Fitchburg, which pays 8 per cent. dividends on the stock.

Nashville, Chattanooga & St. Louis.

The operations for the ten months ending April 30 are reported as follows:

	1875-76.	1874-75.	Inc. or Dec.	P. c.
Gross earnings	$1,489,615	$1,478,527	Inc.. $11,088	0.7
Expenses	869,095	1,016,885	Dec.. 147,790	14.5
Net earnings	$620,520	$461,642	Inc..$158,878	34.4
Int. paid and accrued	365,160			
Surplus	$255,420			

The earnings this year were $4,356 per mile, and the expenses 58.34 per cent. of earnings.

West Wisconsin.

Mr. Wm. H. Ferry, as agent for the trustees under the first mortgage, has taken formal possession of the property, and will continue to hold it for the present. It is understood that no changes will be made in the management or operation of the road. It is said that this action is taken preparatory to the beginning of a foreclosure suit.

Fort Wayne, Muncie & Cincinnati.

In the United States Circuit Court at Indianapolis a petition has been filed by some of the bondholders asking that Mr. A. P. Edgerton, the present Receiver, be removed and Mr. Elijah Smith be appointed in his place. No objection is made to Mr. Edgerton's management of the road, but it is represented that Mr. Smith's appointment will enable a compromise of some conflicting interests to be made. Argument will be heard on the petition shortly.

Alabama & Chattanooga.

The Montgomery (Ala.) *Advertiser* says: "It affords us great pleasure to state that the holders of the $2,000,000 straight Alabama & Chattanooga Railroad bonds have fully agreed to accept the proposition of the State, and have written that they are ready to give up the bonds and accrued interest and take the State's interest in and title to the lands. This will about take up all the endorsed and straight bonds of the Alabama & Chattanooga road, and that part of the debt settlement may be considered a finality."

Utica, Ithaca & Elmira.

A correspondent of the Utica *Herald* says: "Vice-President Rodburn and the directors say that they are going over the surveyed route from Cortland thorough Cincinnatus, Pitcher and Otselic, for a way to Utica, and if it is satisfactory they will put it in running order as soon as possible. Mr. Rodburn has Mr. Knight's survey, and he thinks it the most feasible one he has known. Mr. Goodrich will be superseded as Superintendent of the road in a few days, and Mr. Eldridge, of Elmira, will be chosen President. The President and Vice-President will both be men of means and business."

Wisconsin Central.

On the Portage Extension track is now laid to a point five miles south of Hancock, Wis. This is 33 miles south of Stevens Point, and 10 miles beyond the late terminus at Plainfield. There are yet 34 miles to be finished to reach Portage, upon which work is now progressing steadily.

Union Pacific.

In compliance wi th the late decision of the Supreme Court, this company has begun to run its trains through to the Iowa side of the Missouri River. The first through train crossed the Omaha Bridge May 15.

Erie.

The work of laying the third rail between Elmira and Buffalo is completed, and the first standard-gauge train ran through from Waverley to Buffalo May 22. The train was a special from the Lehigh Valley road, and the occasion was celebrated by a dinner at Buffalo.

There is talk of extending the third rail from Waverley east to Binghamton, 41 miles, to complete a connection with the Albany & Susquehanna.

Dallas & Wichita.

Arrangements have been made to resume work on this road, and it is hoped that it will be completed from Dallas, Tex., northwest to Denton, about 40 miles, this season.

East Line & Red River.

This company has been reorganized, and the new directors bring with them subscriptions in money and land. A contract for the first 20 miles from Jefferson, Tex., westward is to be let soon.

Narragansett Pier.

The grading for this road is now completed and the ties are being put in place. The iron and some equipment have been purchased, and the road will, it is expected, be opened about July 1. It is nine miles long, from the New York, Providence & Boston road at Kingston, R. I., east by south to Narragansett Pier, a noted summer resort.

Rockford, Rock Island & St. Louis.

After receiving the Master's report on Mr. Osterberg's accounts, the United States Circuit Court decided to order the deed of the property to be made to Osterberg as trustee for the purchasing bondholders, according to its previous decision. The Court held that there was nothing wrong in the accounts; some errors of judgment might have been made, but for those Osterberg was responsible to the parties for whom he acted. Mr. Osterberg made a formal statement of his position and authority as trustee.

The road was at once transferred to the new St. Louis, Rock Island & Chicago Company, the formal transfer being made May 20. The consideration for the sale is entirely in the securities for the new company, which issues $250,000 first-preferred bonds; $1,000,000 first-mortgage bonds; $1,750,000 second-mortgage bonds, and $3,000,000 stock. The first-preferred bonds are for money borrowed to complete the purchase; the other securities are to be divided among the purchasing bondholders, the first-mortgage bonds representing the assessments paid. The capital account will therefore be at the rate of $10,950 stock and $10,950 bonds per mile owned.

Arrangements are to be made at once, it is said, for the extension of the road from Sterling to the Chicago & Pacific at Byron.

Grand Southern.

This company invites proposals for the grading and masonry of the Western Division, which is a little over 20 miles long, from St. George, N. B., to Stephen. Proposals will be received until May 30 by J. N. Greene, Chief Engineer, at St. George, N. B.

Chicago & Illinois River.

The Register in Bankruptcy reports to the United States District Court that the proceedings in bankruptcy begun against this company are regular, and that a sufficient number of the unsecured creditors have signed the petition.

Mobile & Ohio.

The United States Circuit Court at Memphis, Tenn., has granted a decree of foreclosure and sale for the 118 miles of the road in Tennessee.

The application for a rehearing on the petition of Mr. Morris Ketchum to have the present trustees and receivers set aside and himself substituted in their place, on the ground of the illegality of their original appointment, will be heard before the United States Circuit Court at Mobile during the coming term. Judge Bradley will preside.

Syracuse & Chenango.

The bondholders' committee, consisting of T. B. Fitch, J. J. Belden and Myron Bangs for the first, and Judge Comstock, Dennis McCarthy and Hiram Eaton for the second-mortgage bondholders, has agreed upon a plan of reorganization. It includes the completion of the foreclosure and organization of a new company, which is to issue $250,000 first-mortgage bonds, $250,000 preferred and $500,000 common stock. The new bonds, the preferred and some of the common stock are to be issued to the present first-mortgage bondholders and the rest of the common stock to the second-mortgage bondholders. The first-mortgage bondholders will have the controlling interest.

Missouri, Kansas & Texas.

A letter from Amsterdam informs us that the committee scheme of agreement was unanimously approved without discussion at a meeting of the bondholders May 2. There were present representatives of $1,481,000 Missouri, Kansas & Texas bonds, of $640,000 Union Pacific Southern Branch bonds and of $25,588 of scrip and shares. The price of Missouri, Kansas & Texas bonds remained about 50 during April, with American buyers constantly in the market, to whom the Dutch holders sold freely.

Chicago & Lake Huron.

Three gangs are now at work on the grading of the gap of 45 miles between Lansing, Mich., and Flint. The Receiver has contracted for 50,000 ties to be used in repairs of the old road.

Wagner Sleeping Car Company.

It is reported that the sleeping cars of this company are hereafter to run over the Toledo, Wabash & Western road, to the exclusion of the Pullman Company's cars.

New York Central & Hudson River.

Over 100 men have been discharged from the Syracuse shops, which is probably a result of the new arrangement by which engines are run through from Albany to Buffalo, the through engines going to the Albany shops for repairs.

The long-trip system has been applied to the Hudson River Division also, and the through-train engines now run between New York and Albany instead of changing at Poughkeepsie as heretofore. The round trip is 300 miles, which the engines will make every day. Train crews will make the trip every other day, and lay off on the intermediate days.

The company has added to its terminal facilities in New York by leasing Pier 25, North River, which will be used as a freight depot. The company is having five car floats or barges built, to carry 10 cars each, which will be used to transfer cars from the Sixty-fifth street depot to the new one. The new depot is near Washington Market, in the lower part of the city. The company has also asked leave to run its dummy engines, which now go to the St. John's Park depot, through West street as far as Pier 25. The new car floats are built by Tundy & Murphy, of Brooklyn.

Lake Erie, Evansville & Southwestern.

Superintendent Pattison has advertised for bids for grading and bridging the extension of this road from Booneville, Ind., to Huntingburg, about 24 miles. His address is at Evansville, Ind.

Lafayette, Muncie & Bloomington.

In the case of Ayres and others against this company and others, the United States Circuit Court has decided to remand the case to the Indiana State Circuit Court, from which it was removed some time ago, holding that it is a matter for that court exclusively, the Federal court having no proper jurisdiction.

Dividends.

Dividends have been declared by the following companies:

American Express, $3 per share, payable July 1. Transfer books will close June 10.

Kentucky Central, 3½ per cent., for the last fiscal year.

New Jersey Midland.

The Chancellor of New Jersey has decided that the Receivers must pay the money advanced by the directors to the road during 1873. The amount is about $22,000. The Chancellor holds that the directors were trustees of the stockholders' interests, and, as they advanced their own money for the protection of that trust, equity requires that they should be reimbursed the amount.

The Receivers continue steadily the work of improving the condition of the road. A construction train is now at work filling in the trestles and ballasting the road between Newfoundland and Hamburg, and the track over the Hackensack meadows is to be new ballasted. Three hundred tons of new rails were recently purchased and will be laid at once. Four new passenger cars have been ordered from the New Haven Car Company.

Meetings.

The following companies will hold their annual meetings at the times and places given:

Des Moines & Fort Dodge, at the President's office, No. 61 Wall street, New York, June 1, at 2 p. m.

Port Jervis & Monticello, at the office, No. 120 Broadway, New York, June 5, at noon.

Utah Central, at the company's office, Salt Lake, Utah, June 1, at 10 a. m.

Nashua & Lowell, in Depot Hall, Nashua, N. H., May 31, at 10 a. m.

Portland, Saco & Portsmouth, at the company's office in Kittery, Me., June 5, at 11:30 a. m.

Cairo & St. Louis, at the company's office in Chicago, June 26, at 10 a. m.

Baltimore & Potomac, at the company's office, corner Calvert and Center streets, Baltimore, June 7, at 11 a. m.

Pacific Mail Steamship Co., at the office in New York, May 31, at noon.

Central, of Iowa.

The *Commercial and Financial Chronicle* of May 20 says: "The announcement is made that at a meeting of the bondholders of the Central Railroad of Iowa, held in the city of Philadelphia on the 13th inst., the Farmers' Loan & Trust Company of this city was removed from its position as trustee under the mortgages, and Mr. Paine, of Boston, and Mr. Bullitt, of Philadelphia, were appointed such trustees in its stead.

"This statement, affecting as it does one of our oldest and most highly respected moneyed corporations, seemed to call for some explanation, and we find the facts of the case to be substantially as follows:

"That the suit for the foreclosure of the mortgages came before the United States Circuit Court of Iowa in October last, and a decree was then made, which, Judge Dillon states in an order in the suit, dated Jan. 14, 1876, was 'the result of consultation and compromise among the parties in interest, and entered as the result of such an agreement, and not upon an independent consideration by the Court of the rights and equities of the various parties.' The decree contained a provision directing the Trust Company to bid at the sale of the road at least the amount of the principal and interest of the first-mortgage bonds, and that, on such purchase being made, the title should pass absolutely to the trustee, in trust for the

first, second and third-mortgage bondholders, and for the creditors and stockholders of the road; and that the property should be conveyed to a new corporation, in which the controlling interest should be given to the first-mortgage bondholders—the second-mortgage bondholders to receive a second class of stock for the full amount of their bonds, and the third-mortgage bondholders and creditors common stock at par for the respective amounts due them; and the stockholders of the original company common stock at the rate of one dollar for every three now held by them. Such an arrangement might be equitable enough, if the first-mortgage bondholders would agree to it; but, although a majority testified their willingness so to do, a minority not only declined to accept the proposed provision made for them, but took an appeal to the Supreme Court of the United States, furnishing the requisite bond (which appeal is now pending), claiming that the Court could only authorize the trustee to buy in the road for their benefit, and could not give the junior encumbrances any interest in the bid.

"The committee which claims to represent a majority of the bonds endeavored to prevent this appeal from being taken on motion before Judge Dillon, and subsequently before Judge Miller, on the ground, among others, that the Trustee had consented to the decree, and failing in this they lately requested the Trustee to allow their counsel to make a motion to dismiss the appeal in the Supreme Court at Washington in the name of the Trustee. The Trustee could hardly have granted this request and maintained an impartial position, as by so doing it would have thrown the weight of its position in favor of preventing the minority from having the question passed upon by the appellate Court. The Trust Company, therefore, declined to be represented by the counsel of the bondholders' committee, but replied that it would, if desired, be present by its own counsel when the motion should be made. The committee then issued a circular recommending a change of trustee, and succeeded in obtaining, as they state, a sufficient number of proxies to effect this result at the Philadelphia meeting. As a matter of law, it would appear that a mortgage, after decree in a foreclosure suit, is merged in the decree, and, if this is true, it is difficult to understand how the present action can be taken. But the courts must settle this, and also the very difficult question as to the right of those claiming to be bondholders to vote. For bonds may be sold any day, and we presume evidence will have to be offered to show that the persons voting, by proxy or otherwise, were the owners of bonds on the day of the meeting.

"If this plan was adopted with a view of shortening the legal complications of this unfortunate road, and hastening the time of its reorganization, no such result is likely to follow. Through the influence of the committee, a decree has been obtained on a principle which we understand that its members themselves have formerly stated, in a letter to the Trust Company, cannot be upheld; and, to prevent the Appellate Court from passing on the point in question, they pursue a course which can hardly fail to give rise to further complicated litigation.

"Meanwhile, from all this there is one lesson for those who may be requested to act as trustees under such mortgages. No position of the kind should be accepted where the trustee is exposed to the possibility, by a provision like that contained in the present mortgage, of being dismissed from his trust either for some technical causes or summarily without cause, and merely by a vote of a majority of bondholders, when the main purpose of having a trustee is to secure a middleman, of entire impartiality, who shall protect alike the rights of all parties interested in the mortgage."

Texas & New Orleans.

Work on this road is progressing steadily, and the road-bed from Houston to the Sabine River is nearly all restored. A construction train is at work laying iron from Beaumont, Tex., westward, and another train is ready at Orange on the Sabine. Three combination (wood and iron) bridges have been erected over the Neches, Trinity and San Jacinto Rivers. The two former have draw spans entirely of iron. The contractors for the rebuilding of the road are Skinner, Gifford & Co., of Dunkirk, N. Y.

Connecticut & Passumpsic River.

The breaks caused by the recent floods have been repaired so that trains began to run through without transfer May 19. Some very long trestle-works had to be built, which are to be filled in hereafter.

New Haven & Northampton.

In the Plantsville depot case the Connecticut Superior Court has granted a peremptory writ of *mandamus* compelling the company to stop its trains at the new depot built by the Plantsville people. The company has given notice of appeal to the Supreme Court, and will, it is said, carry the case up to the Supreme Court of the United States.

The company's answer had previously been referred to the Supreme Court, which decided it to be insufficient and remitted the case to the Superior Court.

New London Northern.

The passenger trains on this road are to be supplied with the Westinghouse air brake. The first train so equipped was put upon the road last week.

Columbus & Toledo.

The first track has been laid on this road, from Delaware, O., northward six miles. This section is being rapidly extended. Tracklaying has also been begun at Carey, where a construction train has been put in service. A large gravel bank has been secured between Delaware and Middletown, and a ballast train will be put on as soon as the track is laid to the bank.

Scioto Valley.

The track of this road has been extended from Circleville, O., southward 10 miles to Kingston, O., and the tracklayers are at work between that place and Chillicothe. The company expects to have the road finished to Chillicothe early in June. The telegraph line is finished to Kingston.

Tuscola, Charleston & Vincennes.

The Illinois Circuit Court has dissolved the temporary injunction granted to prevent the transfer of $40,000 bonds subscribed to this road by the town of Hickory, Coles County, Ill., to Gen. Ayers, contractor for the road.

Railway Purchasing Agents' Association.

The third annual convention was held in Cincinnati, May 18, a large number being present. Reports were received and discussions had upon methods of making contracts; calculation of mileage of freight cars; illuminating oils; lubricating oils; white and colored waste, and several other topics. It was resolved that, in consequence of a mistaken impression that the object of the association was to discuss the merits of supplies furnished by different companies and dealers, in no case will the name of any company or dealer be allowed to be mentioned in the discussions.

The usual hospitalities were extended to the association and the convention passed off very pleasantly.

Spartanburg & Asheville.

The grading of this road is now completed from Spartanburg, S. C., to Cold Spring, 29 miles, except at one rock cut, which will be finished in a few weeks. For three miles beyond Cold Spring there is some very heavy work, including a cut 125 feet deep, on which the contractor has a large force at work. The rest of the line to Asheville, N. C., is all under contract, to be done in 18 months. From Butte Mountain Gap to Asheville the contractors will be paid by the bonds voted by Henderson and Buncombe counties, in North Carolina. The grading in South Carolina has been thus far paid for by local subscriptions, and the company has $250,000 in bonds of Union and Spartanburg counties. The heaviest grade on the road will be 70 feet to the mile, except at Butte Mountain Gap, where there will be a short grade of 197 feet to the mile. The adoption of this extreme grade saves the company some very difficult and expensive work.

Missouri River, Fort Scott & Gulf.

Holders of coupon No. 11, due July 1, 1874, on the first mortgage bonds of this company, are notified that upon surrender of same to Charles Merriam, treasurer, No. 26 Sears' Building, Boston, on and after June 1 next ensuing, they will receive one-half of the face thereof in cash, and the other half in the six-months promissory notes of the company, due December 1, 1876, payment of which is secured by the unpaid balance of the coupons so surrendered, held in trust for that purpose by the trustees.

Central Vermont.

The St. Albans *Messenger* of May 19 says: "The Central Vermont has lately filed in court its bond for $1,000,000 as surety for the faithful performance of its duty as receiver of the Vermont Central and Vermont & Canada roads, having gone on for nearly a year without any bond. The old one had expired and the Chancellor was not aware of it until so informed during one of the Rutland Railroad hearings in the winter. Ever since then the directors have been trying to get sufficient sureties on their new bond. Not all of their own number have signed. There is no record evidence that the Chancellor has yet accepted this."

Eastern.

Application being made to the Supreme Court to appoint the trustees provided for in the agreement with the creditors, it was refused for the present, on the ground that there is a doubt whether the Court, notwithstanding the act of the Legislature, has any authority to appoint trustees in this case or any similar case. The matter will be argued in June before the full Court.

Manchester & Keene.

The contract for the 22 miles of this road from Keene, N. H., east to Greenfield has been let to Tappan & Canfield, of New York. A section of the grading has been sub-let and ground was broken between Greenfield and Bennington last week. Work is to be begun at other points shortly.

Chicago, Danville & Vincennes.

The Court has ordered that all the testimony before the Master in the foreclosure suit be presented by May 28. A decision in the case may be expected shortly afterwards.

St. Louis, Keokuk & Northwestern.

The track is now all laid on the extension from Hannibal, Mo., southwest to Louisiana. Construction trains have run through and the road will soon be ready for regular trains. This extension is about 26 miles long and makes the whole length of the road, from Keokuk, Ia., to Louisiana, Mo., 85¼ miles.

The breaks on the old part of the line caused by the recent high water in the Mississippi have all been repaired and trains are running as usual. The road follows the river pretty closely for its whole length, and is unusually liable to damage from overflows.

Cincinnati Southern.

Tracklaying has been begun at Nicholasville, Ky., and the iron will be put down to the Kentucky River, about 10 miles, for convenience in moving material for the bridge there.

The following contracts on the southern portion of the line were awarded last week: Division C, sections 32 and 36 to Myer & Hay; sections 34 and 35 to Robert F. Bibb; Division E, sections 25 and 26 to Robert McMullen & Son; sections 27, 28, 29, 30, 31, 33, 37 and 38 to Boyle, Roach, Condon & Co.; sections 83 and 84 to W. P. Walton; section 86 to Johnson & Shanahan; sections 90 and 91 to J. C. Rodemer; sections 92 and 93 to R. G. Huston & Co. This work is in Boyle, Mercer and Pulaski counties, in Kentucky, between the Kentucky and Cumberland rivers.

Montclair & Greenwood Lake.

In the suit between this company and Henderson & Dougherty, the contractors who graded a section between Monks' and Greenwood Lake for the old company, the Chancellor of New Jersey has decided that the company has a right to the possession of the road-bed of that section. The contractors have heretofore kept a force upon the ground and have refused to allow the new company to go on and complete the work.

Portland, Saco & Portsmouth.

At the annual meeting, which will be held in Kittery, Me., June 5, the stockholders will be asked to vote on the question of authorizing a mortgage upon the road to secure an issue of bonds to provide for the outstanding liabilities and possible future necessities of the company.

Cincinnati, Batavia & Williamsburg.

This company has filed certificates with the Secretary of State of Ohio extending the line of the proposed road from Williamsburg to Portsmouth.

Springfield, Jackson & Pomeroy.

The grading, masonry and trestle-work of the section from Springfield, O., southeast to Washington, 36 miles, have been let to Leonard & Frazer, of New York, and Ryan & Ohlson, of Springfield. The grading from Jackson to the Scioto River has been let to Sternberger, Pugh & Mitchell, of Jackson Court House; the masonry from Jackson to Waverley to Richardson & Monroe; the trestle-work for the same section to M. Rhoney, of Bainbridge, O., and the ties for the whole line to Burns & McClure, of Jackson. It has been resolved not to let the contracts between Bainbridge and Greenfield until the rest of the work is out of the way.

Southern Pacific.

The iron is laid for seven miles beyond Caliente, Cal., and the road-bed is finished for some distance further. The work has been delayed by failure of the ties to arrive. The tunnels in the Tehachepe Pass are all through except one, of which there are 100 feet yet to be finished. The great San Fernando tunnel is open for 4,480 feet, leaving 2,542 feet yet to be finished. The average rate of progress at latest accounts was 24 feet per day. A very large force is employed, and it is expected that the connection with the Los Angeles Division will be made by July 1.

Oregon Central.

The last section of this road, completed in 1872, has only recently been inspected by the Government Commissioners. It was duly accepted and the land certificates will be issued to the company.

Marquette, Houghton & Ontonagon.

The running of ore trains on this road has begun, navigation being open, and the suspension of business usual in the winter is over. The spring time table shows two passenger trains, a mail train between Marquette and L'Anse and an accommodation between Marquette and Michigamme. On the Eastern Division, between Marquette and Ishpeming, there are nine ore trains each way; on the Middle Division, Ishpeming to Michigamme, there are three ore trains, and on the Western Division, Michigamme to L'Anse, two. The Saginaw and Winthrop Branch has seven ore trains, and the Republic Branch four.

Arkansas Valley & New Mexico.

This company has been incorporated in Colorado for the purpose of extending the Arkansas Valley Branch of the Kansas Pacific from its present terminus at La Junta, Col., southwest to Trinidad. The capital stock is to be $3,000,000, and the incorporators are most of them interested in the Kansas Pacific.

North Pacific Coast.

The grading is finished to Dutch Bill Creek, some 15 miles north of the present terminus at Tomales, Cal., and the tracklayers are at work.

Long Island.

Some improvements are being made on the leased Southern Railroad. The track is being put in good order, and the cuts widened in several places. The road-bed of the Rockaway Branch will be almost rebuilt in season for the Summer travel.

Lafayette, Bloomington & Mississippi.

This road was sold at public sale in Springfield, Ill., May 16, under a decree of foreclosure of the first mortgage, granted by the United States Circuit Court. The whole amount of the bonded debt and interest was $1,445,941.91. It was bought by Mr. John T. Martin, of New York, for account of the bondholders, the price paid being $500,000. The road is 81 miles long, from Bloomington, Ill., east to the Indiana line; it is worked by the Toledo, Wabash & Western.

Marshall & Coldwater.

The contract for the completion of this road from Marshall, Mich., northward to Elm Hall in Gratiot County has been let to a construction company formed for the purpose. The people along the line are expected to subscribe money enough to provide ties and finish the grading and bridging.

Southeastern, of Canada.

Upon this road surveys and location for the remaining 26 miles of the branch called the Northern Division have just been completed under the direction of Mr. Robert L. Harris, Chief Engineer Canada Central Railway.

The Northern Division extends from a point on the main line of the Southeastern Railway (which is part of the "Boston, Concord & Montreal Air Line") at Sutton Junction, 13 miles north of the Vermont State Line, to Sorel on the St. Lawrence River, 45 miles below Montreal. The distance is 96 miles, of which track was laid last year on 70 miles. The portion yet to be built is from Acton on the Grand Trunk Railway to Waterloo on the Stanstead, Shefford & Chambly.

Central, of New Jersey.

This company is building a new ferry-boat, to be called the Fanwood, for the ferry between New York and Jersey City. The boat is 225 feet long, 64 feet beam and 13½ feet depth of hold, and is one of the largest ferry-boats about New York. The engine is 53 inches diameter of cylinder and 12 feet stroke, and is built by Fletcher, Harrison & Co., of New York.

Cheshire.

At the annual meeting, May 10, the stockholders voted to authorize the issue of new 6 per cent. coupon bonds having 20 years to run to an amount not exceeding $250,000, for the purpose of paying off the outstanding bonds due in 1877. The bonds are to bear date July 1, 1876, and are to be of the amount of $500 and $1,000. The Treasurer now gives notice that he will receive sealed proposals for these bonds at his office, Court Square, Boston, until June 15. In allotting the bonds preference will be given to stockholders of the company. Bonds due in 1877 will be taken at par in payment for the new ones.

ANNUAL REPORTS.

Pittsburgh, Fort Wayne & Chicago.

This company owns a line from Pittsburgh, Pa., to Chicago, Ill., 468.39 miles. It leases the New Castle & Beaver Valley road, from Homewood to New Castle, 14.9 miles, and the Lawrence Railroad, from Lawrence Junction, Pa., to Youngstown, 22.04 miles. The whole property is leased to and worked by the Pennsylvania Company.

From the report for the year ending Dec. 31, 1875, which was read at the annual meeting last week, the following figures are taken:

	1875.	1874.	Inc. or Dec.	P.c.
Earn. from freight.	$5,430,510 69	$5,841,960 68	Dec. $411,449 99	7.0
Passengers	2,024,438 29	2,340,986 08	Dec. 316,547 79	14.5
Mails and express.	290,151 00	290,151 00	.....	...
Rents and miscellaneous	118,564 30	126,374 70	Dec. 7,810 40	6.2
Total earn'gs.	$7,863,664 28	$8,599,472 46	Dec. $735,808 18	8.6
Expenses and taxes	4,602,091 66	5,055,330 27	Dec. 453,238 61	9.0
Net earnings	$3,261,572 62	$3,544,142 19	Dec. $282,569 57	8.0
Gross earn. p'r mile	$16,789	$18,375	Dec. $1,586	8.6
Net " "	6,963	7,567	Dec. 604	8.0
Per ct. of expenses.	58.52	58.79	Dec. 0.27	...

The net result of the operations of the year was as follows:

Net earnings of main line		$3,261,572 62
Net gain from working Lawrence and New Castle & Beaver Valley roads		91,706 10
Total		$3,353,278 72
Cleveland & Pittsburgh, proportion of joint freight earnings	$69,446 06	
Miscellaneous	19,000 00	
		88,446 06
Net revenue		$3,264,832 66
Interest and sinking fund payments	$1,059,800 00	
Rental dividends	1,667,000 00	
Expenses of organization, transfer office, etc	19,000 00	
		2,745,800 00
Net gain to lessee		$519,032 66

The lessee expended for betterments during the year $233,948.26, for which special guaranteed stock is to be issued, leaving it as net profit for the year $285,084.40 in cash and $233,948.26 in stock.

The sinking fund is now as follows:

First mortgage sinking fund	$709,000 00
Second " "	854,000 00
Total invested	$1,563,000 00
Cash, etc., in hands of trustees	200,850 46
Total	$1,763,850 46

The President reports that progress has been made during the year in the settlement of the old claims outstanding at the time of the lease. The only remaining suits involving any considerable amount are those for infringements of car-brake patent and the Cawood swage-block patent.

Pittsburgh, Cincinnati & St. Louis.

This company owns or leases and works the following lines:

	Miles.
Pittsburgh, Cincinnati & St. Louis, owned:	
Pittsburgh, Pa., to Newark, O.	159.50
Undivided half of 33 miles from Newark to Columbus	16.50
Cadiz Branch	8.10
Total owned	184.10

Chartiers Railroad, leased, Mansfield, Pa., to Washington	22.80
Cincinnati & Muskingum Valley, leased, Dresden, O., to Morrow	148.40
Little Miami, leased, Columbus to Cincinnati	120.40
Xenia, O., to Springfield	19.30
Xenia to Richmond, Ind.	56.20
	195.90
Columbus, Chicago & Indiana Central, leased. Columbus, O., to Indianapolis	187.70
Bradford Junction, O., by Logansport to Chicago	231.00
Richmond, Ind., by Logansport to State Line	161.80
	580.50
Total leased	947.60
Total worked, including the entire 33 miles between Newark and Columbus	1,148.20

This 33 miles from Newark to Columbus is also used by the Baltimore & Ohio as lessee of the Central Ohio Railroad, the Central Ohio owning the other half interest. The Pittsburgh, Cincinnati & St. Louis owns one-third interest in the St. Louis, Vandalia & Terre Haute Railroad from Terre Haute, Ind., to East St. Louis, which is leased to and worked by the Terre Haute & Indianapolis Company.

The company is controlled by the Pennsylvania Company, which owns a majority of its stock. Its lines form the Southern group or system of the Pennsylvania's lines west of Pittsburgh. The Indianapolis & Vincennes and the Jeffersonville, Madison & Indianapolis are controlled by the Pennsylvania Company and worked in connection with this company's lines.

The present report covers the year ending Dec. 31, 1875. A prominent feature of the report is the clear and full comparative statements of earnings and traffic presented by the Comptroller, Mr. Thomas D. Messler.

The capital account of the company may be condensed as follows:

Liabilities:	
Common stock	$2,508,700 00
First preferred stock	2,928,600 00
Second preferred stock	3,000,000 00
Total stock ($45,830 per mile)	$8,437,300 00
Funded Debt ($81,521 per mile)	15,008,060 99
Deferred liabilities	1,409,633 69
Current liabilities	4,465,881 63
Total	$29,320,876 31
Assets:	
Cost of road	$19,827,550 46
Deferred assets	415,466 21
Due for betterments to leased road	940,694 87
Securities owned	734,554 25
Current assets	2,146,217 17
	24,064,482 96
Excess of liabilities	$5,256,393 35

This excess represents the losses in operating the road and its leased lines up to the close of the year. The stock has been increased $3,550 during the year, and the bonds decreased $2,300. The total amount of debt, less all the assets except cost of road, is $16,646,643.81, or $90,422 per mile. The cost of road reported is $107,700 per mile. The deferred liabilities are chiefly for supplies received with the different leased roads at the time of the leases.

The work done on the 200.6 miles of the Pittsburgh, Cincinnati & St. Louis road was as follows:

	1875.	1874.	Inc. or Dec.	P. c.
Passenger train mileage	652,940	629,867	Inc.. 23,073	3.66
Freight train mileage.	2,106,604	2,385,902	Dec.. 279,298	11.71
Other train mileage	131,715	134,080	Dec.. 2,365	1.76
Total	2,891,259	3,149,849	Dec.. 258,590	8.21
Passengers carried	692,847	672,130	Inc.. 20,717	3.08
Passenger mileage	29,524,628	28,322,181	Inc..1,202,447	4.25
Tons freight moved	1,536,261	1,471,207	Inc.. 65,054	4.42
Tonnage mileage	207,521,453	204 420 561	Inc..3,100,892	1.52

Of the passenger mileage 41.68 per cent., and of the tonnage mileage 46.47 per cent. were of local business. The increased passenger and ton mileage was carried with a large decrease of freight train mileage and only a small increase in that of passenger trains.

The average train loads for the two years were:

	1875.	1874.
Passenger train	45¼	45
Freight train	98⅓	85⅝

The average passenger train load thus remained about the same; but the average freight train load increased 15 per cent. There was, however, a decrease in the rates received as shown by the following table:

	1875.	1874.	Decrease.	P. c.
Receipt per ton per mile, local	1.41 cts.	1.61 cts.	0.20 cts.	12.4
" " " through	.0.86 "	1.03 "	0.17 "	16.5
" " " average	.1.12 "	1.30 "	0.18 "	13.8
Cost " " "	.0.883 "	0.914 "	0.031 "	3.4
Receipt per pass. per mile, local	.3.08 "	3.39 "	0.31 "	9.1
" " " thro'h	.2.17 "	2.40 "	0.23 "	9.6
" " " aver'ge	2.56 "	2.84 "	0.28 "	9.9
Cost " " "	2.063 "	2.364 "	0.301 "	12.7

The earnings of the same line for the year were as follows:

	1875.	1874.	Inc. or Dec.	P.c.
Freights	$2,317,644 58	$2,653,317 53	Dec..$335,672 95	12.6
Express	64,979 81	77,158 94	Dec.. 12,179 13	15 8
Passengers	755,181 41	803,026 77	Dec.. 47,835 36	5.9
Mails	35,400 00	37,200 00	Dec.. 1,800 00	4.8
Rents, etc	2,754 20	2,613 17	Inc.. 141 03	5.4
Total earnings	$3,175,970 00	$3,573,316 41	Dec..$397,346 41	11.1
Expen. and taxes	2,442,008 00	2,576,534 02	Dec.. 134,526 02	5.2
Net earnings	$733,962 00	$996,782 39	Dec..$262,820 39	26.4
Interest received.	9,278 50	.....	Inc.. 9,278 50	....
Net revenue	$743,240 50	$996,782 39	Dec..$253,541 89	25.4
Interest, dis., etc.	874,932 26	843,096 33	Inc.. 31,835 93	3 8
Net profit	....	$153,686 06	.....	....
Net loss	$131,691 76	.....	.....	....
Gross earn'gs per mile	$15,883	$17,812	Dec.. $1,979	11.1
Net earnings per mile	3,659	4,969	Dec.. 1,310	26.4
Per cent. of exps.	76.8	72.1	Inc.. 4.7	6.5

The above result in both years, is after excluding the interest on the $5,000,000 second mortgage bonds, which, under the arrangement made with the holders, is not a charge upon the revenues of the road unless a surplus is shown sufficient to pay the same.

The directors' report says: "The issue of the $10,000,000 of income bonds authorized at your last meeting has, however, been delayed by a question as to the power of the company under existing legislation to create such a security. * * *

"Your track has been much improved during the year by the laying of 4,806 tons of steel rails and 2,679 tons of iron rails, equal to about 37.5 per cent. of the entire length of the main line. There are now 62 miles of track laid with steel rails. There were put in 95,017 cross-ties, equal to nearly 42.5 miles of track, and a considerable quantity of gravel and stone ballast. All these improvements were charged to the expenses of maintenance.

"The condition of your motive power and equipment has also been fully maintained. The amount expended for construction and equipment during the year was $73,667.23, nearly $26,000 of which represents increased cost in replacing by an iron bridge the high wooden bridge over Saw Mill Run, which was destroyed by fire."

LEASED LINES.

From the Comptroller's report are obtained the following figures as to the work done on the various leased lines:

	Chartiers. 22.8 miles.	Cin. & Mus. Valley. 148.4 miles.	Little Miami. 195.9 miles.	C., C. & I. C. 580.5 miles.
Train mileage	49,530	463,400	1,194,718	4,127,477
Passengers carr'd.	115 802	215,798	872,530	736,060
Passeng'r mileage	1,401,331	4,229,265	21,985,261	38,250,743
Tons freight carried	38,047	206,373	497,493	1,370,069
Tonnage mileage.	399,668	11,882,147	38,297,293	239,812,791
Per cent. inc. or dec. passenger mileage	Inc.. 1.33	Inc.. 3.08	Inc.. 3.33	Dec.. 4.30
Per cent. inc. or dec. tonnage mileage	Inc.. 24.66	Inc.. 0.80	Dec.. 0.82	Dec.. 2.99
Earn'gs per train mile	$1.4543	$0.8550	$1.0490	$0.8749
Expens. per train mile	0.7531	0.7779	0.8432	0.7283
Net earnings per train mile	0.7012	0.0771	0.2058	0.1466
Receipt per pass. per mile	3.230 cts.	2.880 cts.	2.300 cts.	2.790 cts.
Cost per pass. per mile	1.495 "	3.557 "	2.196 "	2.345 "
Receipt per ton per mile	5.560 "	2.270 "	1.610 "	1.050 "
Cost per ton per mile	4.092 "	1.863 "	1.351 "	0.931 "
Inc. or dec. in rate per pass. per mile	Dec.0.07 cts.	Dec.0.32 cts.	Dec.0.17 cts.	Dec.0.03 cts.
Inc. or dec. in rate per ton per mile	Dec.0.94 "	Dec.0.02 "	Dec.0.18 "	Dec.0.04 "

The general result shows no large variations from the preceding year in traffic, except on the short line of the Chartiers Railroad, where there was a notable increase in freight movement. On all the lines there was a decrease in the average rate per unit of traffic, coupled, however, with a decrease in freight expenses. The net receipt per ton per mile was: On the Chartiers, 1.468 cents; on the Cincinnati & Muskingum Valley, 0.417 cent; on the Little Miami, 0.259 cent, and on the Columbus, Chicago & Indiana Central only 0.119 cent, a little over one mill per ton per mile.

The earnings and expenses of these leased lines were as follows:

	Chartiers.	Cin. & Mus. Valley.	Little Miami.	C., C. & I C.
Freight	$22,227 89	$257,780 73	$616,522 53	$2,522,592 58
Passengers	45,149 09	121,841 38	504,469 59	926,270 51
Mails, express, etc	4,652 00	16,602 17	121,794 62	170,790 77
Tot'l earn.	$72,028 98	$396,227 23	$1,242,786 74	$3,619,653 78
Expenses	37,301 08	360,482 60	998,914 95	3,013,211 76
Net earn.	$34,727 90	$35,744 63	$243,871 79	$606,442 02
Interest, etc	.....	.....	109,444 00	.....
Net rev'nue	$34,727 90	$35,744 63	$353,315 79	$606,442 02
Rentals, etc	34,727 90	105,000 00	732,202 02	.....
Loss for the year	.....	$69,255 37	$378,886 23	.....
Gross earn. per mile	$3,160	$2,670	$6,344	$6,235
Net earn. per mile	1,523	241	1,244	1,045
Per cent. of expenses	51.8	90.9	80.4	83.25
Per. cent. inc. or dec. gross earnings	Inc. 1.2	Dec. 7.8	Dec. 7.3	Dec. 6.3
Per cent. inc. or dec. net earnings	Inc. 86.2	.....	Dec. 8.5	Dec. 35.1
Expended for betterments	.....	$950 00	$13,465 87	.....

The amount of interest paid for the Cincinnati & Muskingum Valley Company in excess of the net earnings of that line is treated as an advance, to be repaid hereafter from net earnings of the road. Out of the net earnings of the Columbus, Chicago & Indiana Central charges amounting to $24,928.25 were paid; the balance, $581,513.77, is held subject to orders of the Court in the suits now pending with regard to the lease. [Since the date of the report the Court has ordered this amount paid over to the trustees and receivers for the benefit of the bondholders having prior liens on the property.]

The directors' report says: "The aggregate results from the other roads operated by your company, including the Little Miami, Chartiers Valley, Cincinnati & Muskingum Valley railroads, and the Columbus, Chicago & Indiana Central Railway, which has been worked since Jan. 1, 1875, subject to the order of the United States Circuit Court, were as follows:

Gross earnings	$5,330,696 72
Income from securities	109,444 00
Gross revenue	$5,440,140 72
Expenses	4,409,910 39
Net earnings	$1,030,230 34
Amount payable for rental and interest	1,409,116 87
Deficit for 1875	$378,886 23

"To this deficit is also to be added $73,064.01, expenses Columbus, Chicago & Indiana Central Railway, incurred prior to Jan. 1, 1875, but not settled till after that date.

"Considerable work was done on the Little Miami and the Columbus & Xenia Railroads, and the Columbus, Chicago & Indiana Central Railway during the year, and all the lines have been substantially improved and the cost charged mainly to expenses.

"The betterment expenditures thereon were as follows:

Cincinnati & Muskingum Valley Railroad	$950 00
Little Miami Railroad	13,465 87
Total	$14,415 87

for which your company is reimbursed under the provisions of the respective leases.

"The St. Louis, Vandalia & Terre Haute Railroad, in which your company and the Columbus, Chicago & Indiana Central Railway Company are interested, together with the Terre Haute & Indianapolis Railroad Company, its lessee, shows a deficit for the year, which has been charged, however, by the lessee against past profits accrued from the operations of the road. The business of the line is steadily growing, and through the favorable arrangement recently made with the Indianapolis & St. Louis Railroad Company, by which both lines are operated under one management, the public cannot fail to be better served, and improved results obtained through economies in management, and the cessation of unnecessary and destructive competition. * * * * * *

"No change has occurred since the last annual report in the relations of your Company with the Columbus, Chicago & Indiana Central Railway Company. The legal proceedings instituted for the protection of your interests are still pending; but it is believed, and we are so advised, that by reason of the failure of the Columbus, Chicago & Indiana Central Railway Company to perform its covenants under the lease, the lease itself has been practically terminated by their action. It is hoped that the litigation referred to may be terminated during the present year, and that thereupon a fair and equitable adjustment may be arrived at for all interests.

"Several committees representing the bondholders of that company have had interviews with the officers of your company during the past year, having in view the perfecting of a basis for such a financial reorganization of that company that the interest on its funded indebtedness might bear a nearer relation to the present earning ability of the road; but no definite conclusion has been reached."

Shop Employes on an English Railroad.

The following account of the force employed in maintaining and renewing rolling stock on a leading English road, published in *Capital and Labor*, may enable American railroad men to compare the number of employes required in England and America to do the work in establishments of similar extent:

The expenditure of railway companies on materials and wages is known to be vast, but the public has no sufficient appreciation of the greatness of that expenditure. The mere statement of any sum does not convey anything like an idea of the infinite variety of the work, or of the ever-continuing efforts needed to keep the rolling and other stock in a state of efficiency. Selecting, for example, one of the four chief lines in the country—the Northeastern—the figures given are, it may be stated, for a year in which there were not the unduly influencing elements of higher wages or cost of coal, so that they may be taken as an average, representing those of ordinary years. The Northeastern has the headquarters of its locomotive department at Gateshead; it has also truck and wagon repairing shops at West Hartlepool; engine-repairing works at Stockton-on-Tees; engine-repairing and carriage and wagon-building works at York; engine-repairing works at Leeds and at Darlington; wagon-repairing works at Hull and Tyne Docks, as well as the large works at Darlington, Shildon, and other points acquired at the amalgamation with the old Stockton & Darlington railway. The circumstances of the growth of the company—largely by the union of smaller companies, and the purchase of such—is sufficient explanation for the multiplicity of works, and the object we have in view may be best effected by glancing in detail at some of their special features. At Gateshead the extent of the establishment may be indicated by the statements that there are about 1,000 hands employed, as well as about half that number of engine-drivers, firemen, &c., hailing from thence, the weekly wages paid approaching £2,300; and that usually there are in course of repair some fifty locomotive engines. Passing on to the Stockton works, acquired with the purchase of the West Hartlepool Company, it may be sufficient to state that the chief employment is in the repair of some 75 of the company's engines, as well as in the repair of stationary, winding, and marine engines employed in the district. Next are the West Hartlepool Works, where the operations are chiefly truck and wagon-repairing. In a single year the actual work done may be stated as the repairing of some 9,500 coal wagons and 4,000 coal trucks. At the works of the Northeastern (distinct from the Darlington section, which we shall shortly notice), at Darlington, 400 men are usually employed, and their work is the keeping of 60 engines in repair, as well as in actually operating on about 5,000 wagons yearly. At Leeds there is a larger establishment, where about 900 men are usually employed. Of York, as the largest of the southern establishments of the company, a longer, if still brief, notice is necessary. Usually, in the fitting shops, some two dozen engines are undergoing repairs of greater or less extent, and elsewhere boilers are built; carriages are constructed, the wagon shops are capable of turning out above 60 wagons weekly; and the gasometers can make 70,000 cubic feet of gas daily. In one year 419 engines were repaired, 102 carriages and 2,387 wagons were constructed, while 22,185 wagons and 2,864 carriages were repaired. The number of workmen employed in widely varying trades is about 1,600, and the wages paid average £2,500 weekly. In the works formerly belonging to the Stockton & Darlington, at Darlington, some 500 men are employed, and a year's work includes the building of of 16 engines, a score of guard-vans, 1,100 cases of engine repairing, and the oversight involved in the spending of nearly half a million yearly in stores. Of the other works on the section, it is only needful to notice the works at Shildon, where some thousand cases of slight repairs to engines are yearly brought in, and 50,000 chaldron wagons and 37,000 trucks are also in the hospital, the new work consisting chiefly of the building of a score or so of ten-ton trucks. These figures represent, in brief, the work that may be done or that is actually done at the chief establishments of the Northeastern. There is, so far as we know, no mode of acquiring accurate information of the total work done other than by stating the amount paid in wages, and by the deduction that may be drawn from the tabulation of the rolling stock. The new stock actually placed on the line may be stated as well as its cost. For these items, however, the later returns are the most faithful criteria, and we shall give them for last year.

During that year there were 105 locomotive engines added to the stock of the Northeastern, and the sum charged to capital for these was more than a quarter of a million—the figures being £263,966. Of carriages, including luggage vans, the number added was 72, and the cost was £14,573; and the addition to the merchandise and mineral rolling stock amounted in number to 4,103, the cost of which was £495,836. It is much more difficult to state the cost of repairing of the rolling stock, but an approximation thereto may be made. The cost of the repairs and renewals of locomotive power can be fairly stated as costing this company £400,000 yearly; divided between the wages paid and the cost of materials, the former item forms the larger portion of the whole. Similarly the cost of the repairs and renewals of carriages and wagons may be as above, £470,000 yearly, of which wages claims about £160,000, materials about £300,000, and salaries and superintendence the remainder. We have, therefore, an expenditure annually of £870,000 on the repairs and renewals of locomotive and other rolling stock, and a capital expenditure of close upon £780,000 in the provision of additional stock in the same year. There is going on a continual decay of stock, necessitating the breaking up frequently of 3,000 wagons, carriages, and other vehicles yearly. The total has now been reached on the line we are dealing with of 80,000 engines, carriages, and wagons; but this is not sufficient for the demands of the line present and prospective, and a further expenditure of close upon half a million is contemplated. In the item of wages alone, the average amount directly paid for the repairs and renewals of rolling stock and locomotive power is, it will be seen, a total of above £360,000 yearly. To this is to be added the cost of repairs to stationary engines, dock engines, and similar works, so that, exclusive of the building of new stock, the total actually paid to its workmen as wages for the repairing and renewal will be little short of £10,000 weekly. This sum, however, only faintly represents the great whole, and, of course, excludes wholly the great expense attendant on the renewal of the permanent way, and the growing expense attached to the keeping up of the now elaborate system of signalling. There is, in these items which form the total we have gathered, a continual tendency to increase, the claims of the public requiring continual additions, and the demands of workmen causing large increases in cost. Hitherto the increase of traffic has more than met this enlarged expenditure; but now, while every week shows almost a decreased income, the burden of increasing working expenses will be severely felt by the railway companies, and will put a strain upon their resources such as they have never before experienced.